



# Surgery, Gynecology and Obstetrics

An International Magazine  
Published Monthly

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Volume XXVIII  
January to June, 1919

PUBLISHED BY  
THE SURGICAL PUBLISHING COMPANY OF CHICAGO  
3 NORTH MICHIGAN AVENUE CHICAGO

1919

COPY  
THE SURGICAL PUBLISHING COMPANY  
OF CHICAGO

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# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL JOURNAL PUBLISHED MONTHLY

VOLUME XXXIII

JANUARY 1919

NUMBER 1

## SYMPOSIUM ON SURGICAL TREATMENT OF GUNSHOT WOUNDS OF THE CHEST<sup>1</sup>

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### GUNSHOT WOUNDS OF THE LUNG AND THEIR TREATMENT AT THE FRONT

BY MAJOR HIRSH DUBAL PARIS FRANCE  
C H S t h S t h F h A m y

UP to August 1916 gunshot wounds of the lung were not treated by surgical operation. Out of a series of 3,000 cases the general mortality in the advanced ambulances and in the hospitals of evacuation was on an average 30 per cent. this percentage not taking into account a large number of deaths which occurred in the advanced posts and in the base hospitals. The predominant causes of death were hemorrhage mechanical troubles of respiration from open thorax and above all infection of the lung and pleura. Therefore it must be agreed that wounds of the lung are among the most serious of injuries.

My investigations show clearly that a gunshot wound of the lung presents exactly the same lesions as does any other war wound and is subject to the same evolution. Anatomically a wound of the lung like any other wound shows a more or less considerable mass of damaged tissue devitalized by the actual injury. Surrounding the zone of cellular

mortification there is a zone of interstitial hemorrhage. The wound of the lung may contain foreign bodies such as fragments of shell or portions of clothing and this is almost always so when there is a fracture of the ribs or of the scapula splinters of bone being driven in the wound.

A lung wounded by a fragment of shell is always contaminated and later on infected by the same anaerobic germs which infect all war wounds e.g. bacillus perfringens vibrio septicus. There are also often present streptococci as well as those organisms which are the normal inhabitants of the bronchial passages.

A wound of the lung has the same period of infection as any other wound. Associated with it however is a serious complication namely infection of the pleural cavity. Infection of the lung develops from one or more foci of pulmonary congestion either in the injured lung or on the opposite side and these lesions of the lung may vary in extent from

P p d f p s e t a t b e f t h N t h A a l M t t h C l i c g r e f t h A m C H f S g

a small focus of congestion to gangrene of the entire lung. Infection of the pleural cavity arises either from the passage of the projectile or secondarily from the thoracic wound or from the wound of the lung. A very rapid infection of the pleural cavity e. g. traumatic gangrenous pleurisy which kills in 48 to 72 hours is probably due to organisms carried in by the missile itself. Infection of the hemothorax which commences as a rule about the fifth day is due we believe to infection starting within the lung and invading the pleural cavity secondarily. The lung can it is true defend itself to a certain extent against infection but it is not wise to forget that the mortality of wound of the lung from portions of shell is 28 per cent (personal statistics from the Battle of the Somme 1916). According to certain French statistics the mortality in cases of infection of the pleura is more than 30 per cent. Taking into account this terrible mortality and the similarity of wounds of the lung to all other wounds of the war it appeared to us right to apply to wounds of the thorax that logical surgical treatment which we apply to the other wounds. Since 1916 we have treated all wounds of the lung by mechanical excision of the wound, complete cleansing of the pleural cavity, excision of the parietal wound and primary suture of the chest.

#### INDICATIONS FOR OPERATION

Surgical intervention in thoracic wounds is required under the following condition:

1. Operations of urgency. (a) Serious external hemorrhage. (b) Open thorax and mechanical difficulties in respiration.

2. Early operation for wound of the lung.

a. *Serious external or internal hemorrhage.* Immediate thoracotomy, suture of the bleeding wound of the lung or ligature of the bleeding point. The general condition of the wounded man allows the complete surgical treatment of the wound of the lung and of the parietal wound and complete closure of the chest after cleansing of the pleural cavity.

b. *Open thorax.* Some surgeons are content to suture the skin wound without treating the injury of the chest cavity.

Statistics show that this method of combating asphyxia is good but it does not protect the patient from those complications which follow the normal evolution of the lung wound and the mortality of open chests treated by suture alone is about 30 to 40 per cent. In our opinion it is not logical to close the thoracic cavity and not treat the wound of the lung and even when the condition of the patient is serious it is best to perform the complete operation.

*Early operations for wounds of the lung.* Apart from those of urgency the indications for operation for wounds of the lung are difficult to define. The following however may be cited:

All foreign bodies retained in the lung unless they are very small should be removed. All wound of the lung complicated by a fracture of the ribs should be operated upon because they contain splinters of bone (Intrapulmonary splinters are visible only by roentgenography and not by the fluoroscopic screen). Every wound of the lung which on fluoroscopic examination shows a large intrapulmonary hematoma should be operated upon because this hematoma almost always becomes infected. Every tangential wound of the thorax with pulmonary lesion should be submitted to the same treatment.

Apart from these cases through and through wound by rifle bullet without serious hemorrhage and wound containing very small fragments should not be operated upon. It is important to remember however that the comparative freedom of danger in surgical intervention renders the indications for operation more and more frequent.

According to our latest statistics for operations not of urgency we have operated upon 18 cases out of 118. The favorable time for operation on the lung is as soon as possible after the injury. After thirty hours it is as a rule not advisable to perform any operation.

*Results of operation.* In operations of urgency in cases with hemorrhage and open thorax we have cured 66 per cent of our wounded. It will be seen therefore that two thirds of the men in peril from severe hemorrhage or asphyxia can be saved.

In 35 prophylactic operations for infection

of the lung and pleural cavity there were no deaths

Altogether our personal statistics from the Battle of the Somme where excluding operations of urgency cases were treated medically show a mortality of 20 per cent in 300 cases. In a later series when the operative treatment was employed we had 18 cases operated on out of 118 and no deaths. 100 cases treated immediately with 1 death from empyema.

In a total of 136 cases—118 not urgent and 18 urgent—the general mortality was 9 per cent.

It will be seen therefore that surgical treatment lowers the mortality very considerably. What is more when septic complications do occur they are less serious. In the above series we had 11 cases of empyema with 1 death.

Surgical treatment of the lung should therefore be considered as the logical prophylactic procedure to prevent sepsis. Nothing is more suggestive on this point than the following: A man is wounded in the lung by two portions of shell one of which is not located. By operation one of these fragments is removed. The wounded man dies at the end of three weeks from infection; the lobe operated on is perfectly well while the lobe not operated on has become gangrenous and has caused death.

#### OPERATIVE TECHNIQUE

This will be considered under the headings of thoracotomy treatment of the lung treatment of the pleural cavity and treatment of the thoracic wall. Our practice has always been to perform the thoracotomy by resection of 10 centimeters of one rib and wide opening of the pleural cavity. The site of election is through the fourth rib in the anterior axillary line. Complete pneumothorax is not associated with any particular danger and indeed it is necessary for the manipulation of the lung. Complete pneumothorax does not cause any respiratory trouble or increase of arterial pressure and causes less shock than a laparotomy. All our observations prove this. If one takes a blood pressure reading during the thoracotomy one finds that neither the opening of the pleural cavity nor complete

pneumothorax nor handling of the lung causes any lowering of the blood pressure. Complete pneumothorax is necessary because it causes complete collapse of the lung and this collapse is necessary in order to expose and handle the wound. The thorax being opened and the ribs widely separated by the rib spreader (type of Willy Meyer) the lung is seized by a pair of forceps. The lobes of the lung are examined one by one just as one would examine a coil of intestine outside the abdomen in the course of a laparotomy. Protected by a saline pack, each lobe is examined and palpated for any foreign bodies which it may contain; the hilum of the lung and the mediastinum are all easy of access.

The treatment of the wound of the lung itself consists in the complete removal of all foreign bodies whether portions of missile splinters of bone or bits of clothing. The extraction of these foreign bodies is made either through the wound of entry or through a separate incision through the lung tissue. It is an advantage also to operate on a fluoroscopic table because missiles in the lung are sometimes hard to find. The next step in the treatment theoretically is the complete excision of all dead and damaged tissues. Practically this excision is possible only when the wounds are on the surface of the lung or close to the edge. A wound on the surface is excised usually with curved scissors; if at the edge a triangular wedge can easily be removed and a through and through wound can be slit up and then excised. Any bleeding which may occur from this procedure can easily be stopped by suture. In two instances we have been able to remove a third of one lobe of the lung with complete success. Long through and through wounds of the lung can not be treated so thoroughly and one has to resort to swabbing. A wound of the lung treated in this manner is then sutured in two layers, one deep and one superficial. It is necessary to suture the lung in the same way as one would suture the peritoneum. One, two or even six wounds of the lung can be sutured in this manner. Cleansing of the pleural cavity should be carefully carried out. All the blood should be sponged out with swabs on long handles and every little cul-

de sac should be entered and cleaned. Finally we have been in the habit of washing with ether.

Wounds of the parietes should be completed by excision of the muscles and removal of all splinters of bone whether from the rib or the scapula. This is important because if the wound of the thoracic wall has not been mechanically cleansed infection may pass from it into the pleural cavity. If the thoracotomy has not been done through the wound of entry then this must be treated as well. If on the contrary the thoracotomy has been done through the wound of entry then that wound is excised first. Suture of the thorax must be complete. No drain is to be inserted into the pleural cavity nor in the thoracic wall. The chest wall should be closed immediately and completely. We have been in the habit of aspirating the air contained in the pleural cavity and we have proved with the help of Henri Becke by fluoroscopic examinations that aspiration of the pleural air is followed by immediate expansion of the lung and restoration of function. If this is not done a pneumothorax often persists for eight or ten days.

The results of operation are as follows. We have had no deaths apart from those operations performed for urgency and the general mortality has been lowered to 9 per cent. It is very important however to notice that

the degree of recovery is infinitely better after operation. We have been able to follow our cases and screen them at repeated intervals. Following surgical operation the lung recovers its function completely, the chest is transparent to the X rays and the pleura is normal. There is no thickening of the pleura or very little and the diaphragm functions normally. One does not notice those diminutions of the respiratory movements which are so common after chest wounds. One can see that not only is the patient cured but that in the majority of cases the respiratory function has returned to normal.

Surgery of the lung has undergone complete revolution during this war. The lung is no longer an organ inaccessible to the surgeon. One can open the chest widely, expose the lung lobe by lobe, manipulate it, resect it, suture it and treat it as one would a coil of intestine in a laparotomy. Surgery of the lung does not require any of those pressure chambers which the genius of the Germans invented and their persuasion made us think necessary. The French practice of making a wide opening in the chest allows any manipulation of the lung without danger.

War surgery has rendered surgery of the lung easy and without any particular danger. It is our earnest hope that the new field opened to surgery by the horrors of war may be utilized for the benefit of mankind.

## TREATMENT OF CHEST WOUNDS

WITH SPECIAL REFERENCE TO ARTIFICIAL PNEUMOTHORAX

By LIEUTENANT COLONEL PAFFIAELE BASTIANELLI ROME ITALY

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IT is my purpose to present to you briefly the principles and the results of the treatment of chest wounds in general and especially by means of artificial pneumothorax. We are indebted to Forlanini and to J B Murphy for the introduction of this method in the treatment of tuberculosis and other diseases of the lung and pleura and to Major Morelli Forlanini's pupil for its application to war wounds of the chest. As the method has had a steady development under my eyes in a hospital attached to my surgical unit I feel that I can speak from my personal experience.

Classical teaching caused surgeons during the beginning of the war to adhere faithfully to the principle of expectation in the treatment of chest wounds. But soon it became clear that this principle was not tenable in the face of the new facts observed. Truly for the small puncture like wounds produced by rifle bullets without severe bone lesion the principle of expectation may be adhered to at least in regard to life but not always if function is to be considered. Expectant treatment should be followed more rarely for shrapnel wounds and even less frequently for shell splinters.

Consequently little by little the surgeons came to the point of treating actively such wounds and some considered and do consider even now that with few exceptions active treatment should be the rule.

Let us consider first the parietal and then the lung wounds. In the summer of 1916 we came to the conclusion that parietal wounds unless puncture like should be laid open excised and sutured and fractured bones treated as in the limbs. When the pleura is open suture should include it in order to obtain an airtight closure. Suture of the pleura alone is not reliable it is essential that the stitches include the pleura and the muscles in one layer then the skin is stitched sep-

arately. But whenever a hermetical closure seems impossible our advice is to put a gauze plug on the first layer and to suture the skin over it removing the stitches later as the circumstances permit. This is the best means of avoiding aspiration of air subcutaneous emphysema and pus collection. As a rule we try to avoid plugging of the pleural opening itself though as an emergency measure it may undoubtedly be necessary in some cases.

Sauerbruch Duval Calk and others treat lung wounds directly by thoracotomy. This method is especially valuable in checking hæmorrhage or avoiding infection and it affords at the same time an opportunity to inspect the pleural cavity to suture the diaphragm and to remove foreign bodies clots etc. That this ideal treatment which strongly appeals to surgical minds has been followed by good results and that it has opened a new field of action in the treatment of chest wounds nobody doubts. But whether thoracotomy should be applied as a general method or strictly limited to special circumstances is a matter of discussion. Before answering this question let me present to you the pneumothorax treatment in its principles and results so that we may come more easily to a quite different conclusion.

The lung may suffer a *contusion* by non perforating or perforating missiles or a *wound* which may be *superficial deep or perforating*. In a penetrating lesion the parietal wound may be closed to the air immediately or it may close after a short time or it may remain open. In the first instance if blood and air are in the pleural cavity there is no communication with the atmosphere (closed hæmo respectively pneumothorax). In the second instance there is free communication (open hæmo pneumothorax) with the atmosphere small or large according to the wound. We believe that in almost every lung wound there is pneumothorax but such as can be

demonstrated in only about 90 per cent of the case and if it is closed it originates more from the lung than from the external wound in the act of penetration of the missile or soon afterward. This closed pneumothorax may be of various volume and its pressure may be negative or near that of the atmosphere or higher but even a moderate pneumothorax may be under high pressure if the air has been inspired at a low temperature and a large amount of blood has been extravasated.

The open pneumothorax always at atmospheric pressure. Similarly the hemorrhage in the pleura we believe to be constant but naturally not always demonstrable because of its small amount or because the classical signs are not clear in consequence of various and not always perceptible reasons. The origin of the hemorrhage is almost commonly from the lung and if a large vessel especially near the hilum has been severed the hemorrhage will almost always prove fatal and these cases we almost never see. In the other cases it is either immediately abundant or moderate or small at the beginning. But it is very usual to see the hemorrhage increased in the next few days that means that a hemorrhage can go on continually and slowly for hours and days far beyond the limits of time which are generally admitted. The prolonged hemorrhage is due to the fact that in these cases the pressure in the pleural cavity is negative the lung continues to expand and because of these continuous movement and of the suction induced by the negative pressure at each inspiration the vessels are kept open and the blood sucked out until they are closed either by thrombosis or by the closure of the wound or by collapse of the lung induced by the hemo- and pneumothorax.

If no untoward complication arises the air is first absorbed and then the blood and a cure results either complete without functional impairment or incomplete and with functional consequences of great importance. That these last should be reckoned in judging of the efficiency of a method of treatment must be highly emphasized as generally the results are given in figures

of death and cures which by no means can be accepted as sufficient.

In the checking of hemorrhage and in bringing about the closure of the lung wound the most effective agent is the pressure to which the lung is subjected by the blood and by the air accumulated in the pleura. As these therapeutic agents are started by nature so we see cures occur in very severe cases. On these is based the expectant therapy and the principle that the blood should not be removed except in some cases after the danger that the lung wound may open again has passed. We believe on the contrary that this principle is totally erroneous for the following reasons. The pressure which the collected blood alone may exercise on the lung has a relative importance only a great amount of fluid may be efficient and we estimate that 1500 to 2500 cubic centimeters or more according to the chest capacity are required. Besides a fluid collection does not induce complete lung collapse and immobility. Every time the chest expands the liquid can not follow it nor be compressed during expiration so that the lung unless totally collapsed must follow the chest movements. The lung in such condition of incomplete expiration will remain for days and weeks facing points and surfaces of the parietal pleura not corresponding anatomically to the point and surfaces of the lung when expanded. Adhesions occurring in these conditions when firm and old will not allow a complete pulmonary expiration but only of limited zone hence there results in complete pulmonary function displacement of the diaphragm and mediastinum and permanent damage to the lung. Beside the blood is frequently absorbed slowly fibrinous deposits are formed and the complementary spaces obliterated. Sometimes a blood collection remains encysted and there is a continuous source of pleural irritation with effusion of pleuritic liquid and not rarely a reason for infectious complications. Wherever air alone is in the pleural cavity the lung is totally collapsed as soon as the atmospheric pressure is reached and if the pressure is positive the lung is compressed. That means immobility of the lung pressure on the walls of

the wound and their mechanical coaptation. Any hemorrhage except from large vessels is effectively checked and the wound is easily brought to healing with less probability of complications. The air in the pleural cavity means that the lung is completely surrounded by it hence contact with the parietal pleura is impossible and there are no adhesions in abnormal zones of the retracted lung. And when it does expand later even if through inflammatory conditions of the parietal pleura adhesions occur these are on the surface of the totally expanded lung so that the function is perfect even if a complete pleural symphysis occurs. Besides a compression produced by a gas is an elastic one consequently it can follow the chest expansions because the gas is easily rarefied and compressed. When a large amount of fluid is collected on one side the opposite one suffers in its expansion because of the relative immobility of the affected side. Instead it can functionate better when gas is present because gas is easily rarefied and compressed so that from a purely functional point of view the pneumothorax pressure is innocent. And even after weeks the lung can reach a complete expansion. All that we have learned from the observations made in applying the therapeutic pneumothorax in civil practice.

When blood together with air is collected in the pleural cavity the pressure of this pneumothorax we said is variable. As a rule we may say that blood and air quantity are inversely proportional the larger the amount of air or its pressure the less the amount of blood because the hemorrhage is sooner checked. Consequently the hemothorax associated with pneumothorax is a condition more favorable than a pure hemothorax as the air surrounding the lung brings it to collapse checks the hemorrhage and prevents at least partially unfavorable adhesions of the incompletely retracted lung.

The presence of air in the chest is then to be considered the most favorable condition for the cure of lung wounds and we have only to follow and imitate nature in treating them. That means remove the blood which is dangerous and put in its place air which is favorable.

When we are confronted with open pneumothorax our conduct is clearly indicated. We must change the open pneumothorax into a closed one so that we may later effect the introduction of air as a therapeutic measure. Besides an open pneumothorax induces severe functional symptoms which are commonly resumed as traumatopnea so that the closure of the wound is necessary. We believe that this is necessary so that a complete airtight closure results. If the hemorrhage is severe it means that a large vessel has been severed and that the atmospheric pressure can not check it. Then it is safer to enlarge the wound and deal with it surgically. But in other cases we can safely resort to the complete closure followed by introduction of air as this will invariably stop all the non immediately fatal hemorrhages. These cases give a high death rate through either functional disturbance hemorrhage or septic complications. The more prompt and complete the surgical intervention the less will be the bad consequences and we believe that in these cases too the airtight closure of the wound followed by artificial pneumothorax is the best and the simplest measure to be resorted to. But if there is a large parietal wound with rib fractures and depression of the chest wall then it is quite necessary that the lung be inspected and the wound treated accordingly by hermetical closure if possible at least of the deep layers resorting to partial plugging as seldom as necessary. The very severe functional symptoms which these cases not infrequently present must be treated as soon as possible. In the advanced dressing stations we have found the Morelli rubber bags very efficient. These bags are of different sizes (Fig. 1) which can be introduced empty into the wound and then blown up with air so that they completely fill the opening. The advantages especially in double wounds and in crowded days are clear and we believe that the introduction of the bags as an emergency measure should be favored as it may save lives and give immediate relief and prepare better conditions for the definitive treatment which can even be delayed without damage.



The preceding considerations make clear the importance of the following three points

- 1 Airtight closure of the parietal wounds
- 2 Evacuation of blood
- 3 Introduction of air

I have dealt sufficiently with the certain damages and with the imperfect results which the blood collection may produce. I have now to prove that the removal of the blood is not dangerous. This opinion is still erroneously held by the surgeon who do not know the advantage of artificial pneumothorax because they fear the possibility of a new hemorrhage after removal of the blood present and reestablishment of the suction power of the pleura and the mobility of the lung. But if we can maintain in the pleural cavity an atmospheric or a positive pressure the lung will necessarily be kept in a state of collapse and immobility. This is easily accomplished by introducing in the pleural cavity a quantity of air corresponding to the amount of blood we remove or if we fear the possibility of a prompt hemorrhage we may introduce a certain amount of air previous to the extraction of the blood so as to be able to keep permanent positive pressure on the chest. With these rules the removal of blood is a safe procedure and as we have demonstrated the danger and the inutilty of it prevent there a no return why it removal and the induction of an artificial pneumothorax should not be advised as a general indication.

Consequently we believe that every penetrating chest wound with closed hemo and pneumothorax should be treated in this way and if the blood is removed even in cases in which its amount is small the result will be better. For this reason we advise the use of explorative puncture to clear the physical signs which is not always easy remembering that the puncture has to be made high because of the high position of the diaphragm in these cases and the procedure may be repeated if necessary.

Moreover cases apparently mild of sure pulmonary lesion whether a contusion or a wound must be treated by the introduction of air for it is not unusual to see in such cases when left to nature the occurrence of hemothorax forming slowly in the

next few hours or days in consequence of the negative pressure sucking blood from the vessels and keeping the wound open. Besides not seldom we have seen broncho-pulmonary complications and abscesses in cases of pulmonary contusions and secondary hemorrhages from lung wounds left to nature which by artificial pneumothorax could have been avoided.

There are naturally different clinical and physical conditions in a chest wound and consequently various indications for treatment which may be summarized as follows

1 Closed parietal wound with no demonstrable hemo and pneumothorax or if present very moderate. In this group of cases the production of a pneumothorax is indicated and it should be progressively increased as a preventive measure. If instead a pneumothorax is demonstrable without noticeable hemothorax we should test its pressure and if it is too high and producing functional disturbance the pressure should be diminished. Abundant hemothorax with moderate spontaneous pneumothorax require withdrawal of the blood and introduction of air so as to increase the pleural pressure to a positive one. But if with large blood collection there is spontaneous pneumothorax under high pressure this means that a high pressure has to be maintained to keep the hemorrhage in check and we have the indication for the withdrawal of blood and the introduction of as much air as is necessary to keep the pressure at the same height.

In an open parietal wound airtight closure is indicated after letting the blood out and favoring the entrance of air. The pressure is increased with a further introduction more or less according to the hemorrhage. It should be remembered as a thing of great importance that pneumothorax is of great value so that should we be working under crowded condition having no time for a complete study and for the systematic evacuation of blood it will be enough in the first few hours or days to perform an artificial pneumothorax or to increase the existing one and to postpone the extraction of liquid to a better time. We consider the

artificial pneumothorax as a powerful means of treatment capable of giving good immediate and the best definitive results and consequently we recommend it not for few and special cases but as a general measure.

These extensive indications for artificial pneumothorax are admissible only if we can prove that it is a safe and easy procedure. The dangers attributed to it are the spontaneous air embolism or that due to the technique are matters for long theoretical discussion. I will say only that theory and practice combine in the conclusion that with proper technique these dangers can be easily avoided and Major Morelli claims that in his unique practice these never happened. It is easy to understand that when blood or air is present in the pleural cavity the needle can not enter the lung so that an error seems to be impossible but in cases of pulmonary contusion or absence of a demonstrable quantity of air or blood in the pleural cavity or when adhesions exist the technique is more delicate and comparable to that of the ordinary therapeutic pneumothorax and naturally experience and prudence are required.

Anybody who wishes to adopt this method of treatment should be familiar with the principles of therapeutic pneumothorax and understand its application in chest wounds. For this reason there have been introduced in Italy special courses for medical officers in one of the hospital specializing in the treatment of chest wounds.

The original Forlanini apparatus or some of its many modifications may be used. We prefer the one devised by Major Morelli as being easily transported and making impossible air embolism through technical faults. A glance at the figure (Fig. 2) will explain its use. The main feature is that the air can not be blown into the pleural cavity but it is automatically aspirated by the chest from the bag which has previously been filled up with air. The pleural cavity will according to the pressure existing in itself aspirate or expire into this bag as if it were the surrounding atmosphere and in this way there is no possibility of air embolism even if the needle had entered the lung. When blood

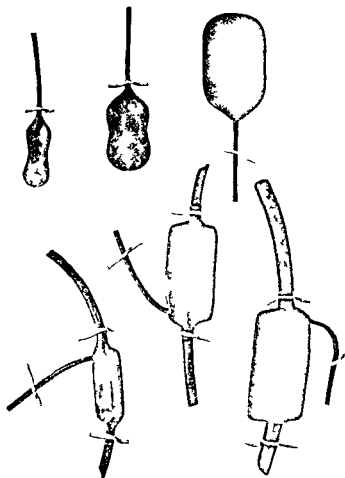


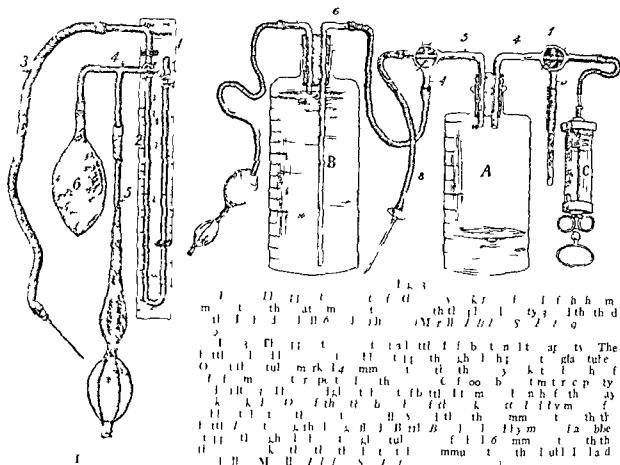
Fig. 1. The upper rubber bags are used to plug a chest opening. The lower rubber bag, with interior drain air for suction treatment of empyema (Major Morelli).

has to be removed Major Morelli uses the apparatus shown in Figure 3 which lets out the blood, puts air in the pleural cavity and washes the cavity if desired and so makes certain the removal of all blood from the chest.

The artificial pneumothorax must be continued for 12 to 15 days by the successive introduction of air measuring each time the manometric pressure.

The results are shown by the following statistics which I have compiled from figures kindly collected for me by Captain Vercesi including all cases treated in Field Hospital No. 79 under the direction of Major Morelli up to the end of June last.

The chest wounds coming from one section of the firing line regardless of their severity are all brought directly to this hospital which is specially dedicated to the treatment of these cases so that it collects all of the



1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100

chest wound of the corresponding zone. Besides the hospital can keep the patient until the cure has been completed. The circumstances are of great importance in judging the value of statistics.

T	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
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The lung contusions offer an interesting field for study and for treatment but I prefer not to deal with them now. Of the 90 penetrating chest wounds there were with closed chest 206 with open chest 84.

**1. Closed chest.** This is the category of cases which gives the most occasion for discussion as in these there is frequently no apparent reason for intervention. We believe that in the case especially the evacuation of blood

and the production of a pneumothorax are most extensively if not generally indicated. However the operations are usually not operated on except when the patient has suffered a very severe injury when thoricotomy is too often done.

Of these 206 cases there were 88 treated by pneumothorax and 118 treated by thoracentesis and pneumothorax with a mortality of 7 or 34 per cent. Of these were due to emphysema to pulmonary abscess 3 to opticoma.

**Open chest.** Total cases 84. Deaths 19 or 26 per cent. Of the 19 dead 7 died before reaching the hospital 7 had bled and were shocked so severely that nothing but perhaps transfusion could have helped them they died in the first 4 to 48 hours.

Admitting that it is fair to subtract these 8 cases we have remaining 16 in which the treatment could be tried.

In these 76 there were 11 deaths or 14.4 per cent. Of these 7 were due to empyema, 4 to septicæmia. Empyema occurred altogether 11 times. I must specify the fact that empyema occurred only in the cases treated by permanent closure of the parietal wound with the rubber bag. Since this procedure has been resorted to for emergency only and the wound has been sutured airtight according to my principles we have had in 35 cases 2 deaths or 5.7 per cent.

Altogether the results of the treatment of penetrating wounds with pulmonary lesions were

Total case	90
Total deaths	26
or 28.9 per cent	

If we subtract the 8 cases above mentioned we have

Total case	8
Total death	18
or 62.5 per cent	

The results of a method of treatment can not be estimated only under the headings of cured and dead; the definitive conditions of function and disability must also be considered. The great majority even of the most severe cases which were cured had a perfect integrity of function as shown by X-rays and by late examination. Many patients could get up on the eighth, twelfth or fifteenth day and in a short period were fit for service.

There are conditions in which pneumothorax can not be performed and I like to summarize these under this principle. When ever air cannot be introduced into the pleural cavity because of adhesions or because the air escapes from it either through the parietal wound or through the lung wounds then it is natural to resort to the complete operation. We resort to it whenever the chest wall is largely and badly shattered for it is the shortest part of the operation

to inspect and to treat the lung directly and if the chest wall can be closed airtight it is advisable to maintain the natural pneumothorax by introducing air later. When there is threatening emphysema and it is due to adhesions we advise that the wound be enlarged and to detach it and suture it completely. And finally if foreign bodies are in the pleural cavity we believe that these must be removed for very frequently they do cause infection while foreign bodies in the lung do not need to be systematically removed but only those of a certain size or when the complete operation is required. The lung can take care of foreign bodies very well and in a quite different way if it is collapsed and immovable for many days than when it is left free to expand.

In my experience and Morelli's it has never been necessary to resort to an open operation to check lung bleeding but naturally this may be an absolute indication.

So that answering now the question first proposed I would say that the complete operation has rather limited indications while the removal of blood followed by pneumothorax has a most extensive almost a general indication in closed chest wounds and less frequently in open chest cases. The treatment of the chest wall wound must be the rule. Local anesthesia has proved sufficient and perhaps superior to ether or chloroform.

Thoraco-abdominal wounds are not discussed in this paper as they require quite different methods of treatment. Certainly they may often require intervention from the thoracic side for the treatment of the lung lesion or of the abdominal organs and this is certainly true in injuries of the diaphragm especially on the left side. I wish to call attention to the fact that suture of diaphragm through a thoracotomy incision was first practiced more than 5 years ago by Dr. Postempski of Rome.

## THE EARLY TREATMENT OF GUNSHOT WOUNDS OF THE CHEST

BY COLONEL C. I. CASK, D. S. O., L. R. C. S. (L.), F. R. C. S. (G.), F. R. C. P.

**D**URING the last two years there have been great changes in the treatment of gunshot wound of the chest. During the first two years of war very little was done. The usual treatment afforded was to put the patient to bed, give him some morphine and a cough mixture and hope for the best. If an empyema formed then a portion of rib was excised and the pleural cavity was drained by means of a tube. A might be expected the mortality was great and in a fatal case confidence was often prolonged.

The reasons for the non-interference were three: (1) experience of the South African war where the ground was dry and clean and where wounds were largely due to rifle bullets led our surgeons to the belief that chest wounds were best left alone; (2) it was believed that it would be fatal to open up the chest cavity without the aid of the form of pressure chamber; (3) it was thought that handling of the lungs would provoke fat and fatal bleeding. Experience has proved that the chest is *empty* *is* *wrong*, and a complete change has been made in our practice not from the discovery of any new method but by the application of the principles of the general principle of surgery which govern the correct treatment of all wounds, namely their early mechanical cleansing by aspiration followed by early closure.

*Types of wounds.* The type of wound which are most commonly met with in a Casualty Clearing Station are as follows: (1) through and through wound caused by rifle bullet; (2) through and through wound caused by shell fragment; (3) lodging wound with retention of large foreign body; (4) lodging wound with retention of small foreign body; (5) open sucking wound of thorax with or without retention of foreign body.

*Causes of death and prolonged illness.* If the complicating wound are disregarded the cause of death from pure chest wound may be divided into 3 groups: (1) deaths on the

battlefield or in a few hours after admission to a medical unit due to injury to large vessel or extensive lesion which cannot be aided surgically; (2) death after 48 hours—these are almost always due to escape of the pleural cavity and its contents; (3) deaths at the Base after 7 days. In the case again the cause of death is almost invariably escape. Therefore the guiding principle in treatment of chest wound is in any other wound must be the elimination of contamination before organisms have had time to invade the tissue.

*Chance of infection.* Crutched that the chief danger to a man wounded in the chest is infection it is necessary to see how organisms reach the chest cavity.

The pleural cavity may be infected: (1) by the milk and portion of the clothing or equipment carried in by it; (2) through the wound in the chest wall. A wound that opens directly into the pleural cavity through which air is constantly sucked will always lead to infection unless dealt with at once. Further it is well known even if moderate dimensions through which air is not being sucked unless adequately dealt with may appurate in the course of a few days and if the thoracic cavity is not closed off organisms gain entrance to the pleural cavity where they find the blood a convenient medium for growth. The account for many cases which exhibit septicaemia only after an interval of five or six days. (3) From the wound of the lung in which missile, splinter of bone or portion of clothing may be retained.

The principle therefore to be aimed at is the early mechanical cleansing of the wound both of the chest wall and of the injured viscera, the evacuation of all foreign bodies and of effused blood from the pleural cavity, the repair or suture of the damaged lung and the closure of the chest cavity by suture.

*How to arrive at this.* When a patient suffering from a chest wound is admitted to a Casualty Clearing Station he is put to bed

and allowed to rest undisturbed to recover from shock.

The only exception to this rule is when there is a large open blowing wound of the chest. In such a case the opening is immediately closed by temporary skin suture. The relief given is immediate so much so that there is now a general order to the effect that a blowing chest wound should be sewn up at the earliest possible moment in the advanced medical units. A survey is then made of the whole patient and all wounds examined. Evidence of hemothorax, pneumothorax or collapse of lung is sought. Much may be gained by careful examination of the movements of the chest and the position of the heart. The whole body should be searched for complicating wounds, especially with regard to abdominal and spinal injury.

**X-rays.** Patients with retained missiles should be submitted to X-ray examination for information concerning (1) the position and size of the foreign body, (2) the existence and extent of hemothorax and pneumothorax, (3) the condition of the opposite lung, cardiac displacement and movement of the diaphragm.

**Indications for early operation.** (1) a ragged wound of the soft parts, (2) bleeding from the parietal wound, (3) compound fracture of the ribs, (4) suction of air into the pleural cavity, (5) retention within the chest of a large foreign body, (6) great pain due to driven splinters of bone, (7) rapidly increasing pneumothorax due to a valve-like opening into the pleural cavity which allows air to be sucked in and prevents expulsion, (8) a large hemothorax which cannot be evacuated by aspiration.

When none of the indications are present that is when the wounds of the chest wall are small and clean such as made by a rifle bullet when the ribs are not splintered when the foreign body retained is small the patient is treated on general medical principle.

**Treatment by operation—time of operation.** The best time is as soon as possible after the receipt of the wound provided the patient has recovered from the initial shock.

**Anæsthetic.** Patients bear operation well and take a general anæsthetic satisfactorily. It is unnecessary to use any form of pressure

chamber. My own predilection is for chloroform either by itself or combined with oxygen given through a Shipway's apparatus. Gas and oxygen is very good and the French commonly use ether and many British surgeons employ local anæsthesia. It is evident therefore that the anæsthesia so long as it is administered skilfully presents no difficulty.

**Wounds of the soft parts of the chest wall.** Wounds of the soft parts unless small and clean should always be excised even if nothing further is done because otherwise they suppurate and infection is liable to spread along the track of the missile into the pleural cavity.

**Fracture of ribs.** Excision of the soft parts leads the surgeon to the rib. More often than not the rib or scapula are broken and whether or not the chest is to be opened the splinters of bone should at least be removed. Ragged end of rib cut clearly off and all dead tissue excised.

That is to say the first step in the treatment of a chest wound is to make a careful complete excision of the parietal wound. In some cases this is as far as the surgeon should go. Careful excision of the wound allows a careful examination which may reveal either a bleeding intercostal artery or a large hole hitherto unsuspected leading into the chest and a finger introduced into the pleural cavity may discover splinters of bone either free or sticking into the lung. Such splinters ought to be removed for they play a great part in the production and maintenance of empyema.

At this stage the case has been converted into one of open hemothorax. Two courses are now open to the surgeon: (a) he may do what is called the complete operation opening the chest, repairing the lung, cleaning and closing the pleural cavity, or (b) he may content himself with the excision or suturing of the parietes after evacuation of the blood from the pleural cavity either by rolling the patient or by aspiration. The decision may be difficult. My belief is that if any operation is undertaken for a penetrating wound of the chest it should be done completely as yielding in the long run the best result.

**Retention of a large foreign body.** By a large foreign body is meant a shell fragment of about 1 inch by 1 inch. Such a fragment not

only injure tissue but carries in with it fragments of clothing which unfailingly cause contamination. Therefore it should be a rule that all large missiles should be removed at an early date. The operation may be done either by enlarging the original wound or by a fresh incision and the surgeon guided in his choice by the position of the missile as seen by the X-ray relatively to the wound. Where possible thoracotomy through the wound is preferred but in any case the original wound or wound must be completely excised. A fresh thoracotomy may be done by resection of four inches of rib by an incision in the intercostal space. The easiest route is probably via the fifth rib in the anterior mid axillary line through such an incision with the use of a retractor or rib spreader any part of the pleural cavity can be reached. On looking into the chest thus opened the first thing seen is a quantity of blood the majority of which is unclotted—at any rate at the time of which I am writing—namely the first or, day after injury. This must be removed by mopping. The cavity of the chest is now visible the chief object seen being the collapsed lung, the dome of the diaphragm and the mediastinum.

The missile may be evident at once but it may not it may be sought by inserting the hand into the pleural cavity if it is lying in the lung it can be felt with the finger and removed either through the wound if entry in the lung or by fresh incision into lung tissue.

Lung tissue may be excised without fear because any fresh bleeding following incision is easily controlled by suture. Continued bleeding from the lung is exceedingly rare.

*Arrest of bleeding follows spontaneously from collapse of the lung and early operation within 1 hour after injury does not cause re-rupture of bleeding.* In the few cases observed in which bleeding did continue the cause was due to old adhesions which prevented the lung from collapsing. The wound in the lung itself should be excised when possible in the same way as a wound of the soft parts. That is to say it should be cleaned mechanically and sutured. It should be sutured for two reasons (a) even if not completely freed from organisms there is evidence that the lung is capable of dealing with a considerable amount

of infection is evidenced by the rarity of gas gangrene infection (b) restoration of function is hastened.

*Abdomino thoracic injuries.* Injuries involving both the chest and abdomen are not infrequent either as the result of a single or multiple injuries.

When a missile has traversed both chest and abdomen the diaphragm is necessarily injured and abdominal viscera may herniate into the pleural cavity. This is more commonly found on the left rather than on the right side because on the latter the liver gives protection.

The diaphragm can only be repaired efficiently from above therefore it is wise to open the chest first replace the abdominal viscera suture the diaphragm deal with the chest already indicated and then if there is evidence of injury to the hollow viscera laparotomy may be performed. The passage of a small missile through the diaphragm may not necessitate repair in such a case with evidence of injury to hollow viscera the abdomen is afforded preferential treatment.

*Hemothorax.* The question often arises as to the correct treatment for a patient with hemothorax of moderate dimensions and in whom there is no retained missile and no large wound of the parietal thorax that is to say of uncomplicated hemothorax. The majority of these cases recover with aspiration. A certain proportion however become infected. If it were possible to foretell which cases would become infected then there is no doubt that the chest should be operated on at an early stage the hemothorax evacuated the damaged lung repaired and the chest closed. So far as I know there is no way of foretelling this and to prevent any possible infection it would be necessary to operate on every case and that I am not prepared to advocate at this moment seeing that many of them get well by themselves.

At the present time we content ourselves with aspirating the hemothorax completely is possible and making every effort to detect signs of infection at the earliest possible moment.

The only certain evidence of infection is either a positive bacteriological finding or the

removal of stinking fluid. By clinical signs it is often possible to diagnose the existence of infection before organisms can be detected by the bacteriologist.

The essential treatment as soon as infection is proved or suspected is to empty the chest of all blood and clots. This cannot be done by aspiration and must be done by open operation. The common practice has been the resection of an inch of rib and insertion of a tube. Provided the operation is done within a few days after receipt of wound it is better to do a wider resection, cleanse the pleural cavity and close the chest subsequently keeping the pleural cavity dry by aspiration. This method offers the following advantages: (a) the chest may remain closed; (b) the lung is allowed to expand and adhesions may form which will prevent complete collapse even if the pleural cavity is subsequently drained; (c) respiratory distress is much less with a closed chest; (d) if infection persists and the chest has to be drained, it is very easy to take out a few stitches and insert a tube. Drainage of a chest like amputation of a limb should be regarded as a surgical failure.

*Contra indications for operation.* (1) Shock and collapse such as would be contra-indicative for any surgical procedure. (2) Small clean wounds without evidence of serious intra-thoracic injury. (3) Collapse of the opposite lung as indicated by inspiratory retraction of the chest wall on the side opposite to the wound. In this case an anæsthetic on opening of the chest may be fatal.

#### OPERATIVE TECHNIQUE

*Thoracotomy through the wound.* The first essential is the complete excision of the wound including the skin, muscles and broken ends of rib. This having been completed the chest should be opened with fresh instruments. An incision is made from the edge of the wound through the skin along the line of the broken rib either forward or backward to obtain the best access to the cavity of the chest. Then the muscles are incised down to the rib retracted and the periosteum incised along the middle line of the exposed rib. Along this line the periosteum is stripped off with a

rugine. A Doyen's periosteal rib elevator is then slipped in and the periosteum entirely separated. The bone is then cut through with a pair of rib shears or bone forceps and removed. To allow free access to the pleural contents and insertion of the hand it is necessary to take away four inches of rib. The posterior layer of periosteum of rib with the parietal pleura attached is next incised with a pair of scissors along the middle of the gap. Then a retractor or rib spreader is inserted and the chest opened widely.

*Thoracotomy by fresh incision.* As previously stated this operation may become necessary when thoracotomy through the wound will not allow access to the injured portion of the lung for instance when the wound is in the lower and posterior part of the thorax and the foreign body near the hilum or in the upper lobe of the lung.

*Choice of route.* Resection of four inches of the fifth or sixth rib in the anterior axillary line gives a good exposure of the thoracic contents and if there are no other considerations this is probably the best and easiest route to follow. It has to be remembered though that if drainage of the pleural cavity has to be performed later on it cannot be done effectively through this incision. Therefore if the nature of the wound and missile is such as to indicate probable future infection it may be advisable to choose a lower rib and make the incision more posteriorly.

*Operation.* A six inch incision is made along the line of selected rib and continued down to the periosteum which is stripped off the anterior surface with a rugine. With rib elevator and shears four inches of the rib is resected. The posterior layer of periosteum with the parietal pleura attached is then incised along the whole length of the middle of the gap and the retractor or rib spreader inserted.

#### ALTERNATIVE METHODS OF OPENING THORAX BY FRESH INCISION

1. Incision through intercostal space with or without section of one or two costal cartilages. A good exposure may be obtained by this method provided the patient is young and has elastic ribs.



Before the war the pleuro costal flap method was advocated. This is unnecessary and prolongs the operation.

3. Cowell has suggested that the rib should be split along its longitudinal axis. This method merits trial.

#### PROCEDURE WITHIN THE THORACIC CAVITY

After the chest has been widely opened either through the wound or by fresh incision it is advisable to remove the blood from the pleural cavity first because it is easier to see what has to be done and secondly because removal of the blood relieves respiratory difficulty by lessening pressure in the mediastinum. The blood can be removed by rolling the patient on to his side. Probably however it is better to do it by wiping with gauze and sponging out the clot with the gloved hand. No disturbance is caused to the patient by this method.

Then the gloved hand should be inserted into the pleural cavity and swept around in order to detect and remove any splinter of bone which may be lying free or the muscle and portions of clothing. The arteries are most likely to be found in the pleuro diaphragmatic reflexa.

Next the foreign body if retained in the lung may be detected by the finger and with the aid of two pairs of lung forceps the affected area is brought into the opening of the chest. The lung can be handled as easily as a coil of intestine and without causing a great deal of blood pressure.

#### FLATTENING OF THE WOUNDED LUNG

A foreign body when present seems to be generally near the surface of the lung and can easily be removed. It necessitates a small incision may be made through the lung substance.

The hole in the lung should now be explored for splinters of bone and freed of clothing and cleansed as far as possible by swabbing. When there is a large ragged wound and it is

anatomically possible a wedge of lung may be removed or the edges of the hole clipped with scissors.

In any case whether the wound is excised or not it should be closed by catgut sutures in either one or two layers according to the depth of the wound. Bleeding is easily controlled by such suture.

#### CLEANING OF THE PLEURAL CAVITY

In most cases it is only necessary to cleanse the pleural cavity by swabbing it dry and clean. If however there has been much soiling it is advisable to wash it out with either warm saline or eucal. In any case however the chest should be left dry as a central factor in the early expansion of the lung.

#### CLOSURE OF THE CHEST

Whether the operation has been performed through the wound or by fresh incision the chest should always be closed. The relief afforded the patient is instant and marked. An attempt should be made to repair the chest wall in layers: pleura to pleura muscle to muscle and skin to skin.

Where a large hole has been blown through the chest wall it may be impossible to make the edges of the pleura meet in that case muscle should be made to cover the gap even if a flap has to be cut. Finally the skin should be closed by interrupted sutures. In the majority of cases healing will be by primary union.

#### POSTOPERATIVE TREATMENT

Regular postoperative aspiration is generally required to keep the pleural cavity dry for usually after a big operation there is a fluid exudate which if not removed may become infected. I believe this plan of treatment is thoroughly sound and in accordance with the principle of surgery and if it could always be carried out I believe that many lives would be saved and much prolonged illness avoided.

## THE LATER STAGES OF GUNSHOT WOUNDS OF THE CHEST

BY MAJOR G. GREY TURNER, F.A.M.C. (T), NEWCASTLE UPON TYNE, ENGLAND

My interest in these cases was first aroused soon after the beginning of the war by the numbers of men who arrived at home hospitals wounded in the chest and complaining either of persistent shortness of breath with cough and other irritative symptoms or only suffering from the knowledge that they harbored foreign bodies.

In those days it was the rule to look upon chest wounds as beyond the scope of legitimate surgical enterprise and the rule which guided the practice of those at the front was extended to the quiet areas behind the battle line. It soon became obvious that a great many of the cases labeled as gunshot wound of the chest were only suffering from injuries of the parietes. In others though the wound of entrance was on the surface of the chest the missile was lodged in some part outside such as the scapula, the neck, or even the abdominal cavity. I therefore determined to look into all chest wounds from the point of view of the surgeon with a view of determining if anything could be done for their relief and I soon learned that this was a profitable line of investigation.

These cases reach us either direct from France or as return cases that is to say men who have rejoined their regiments or who have reported at Command Depots and who have broken down under the strain of duty or graduated training. It is surprising what a large group these latter cases form and it teaches that in attempting to estimate the time necessary for recovery after war wounds it is not enough to state that a man was returned to duty but that it is necessary to know of his progress for months or years afterward. Lastly there are those who come to us as pensioners — men discharged from the army — for whom special provision is being made at our civil hospitals and who are seeking relief in increasing numbers.

For some considerable time now it has been the practice in some of the armies in the

field to treat gunshot wounds of the chest by early operation. These men reach us in various stages of recovery and the results are very much better than in those treated by expectant methods. The fewer cases coming to England for operation is an evidence that the first line of surgical defense is moving still nearer to the battle front and that this earlier and more complete treatment is rapidly diminishing the need for secondary operations. Among the total number of cases arriving from overseas the mortality is exceedingly small.

## THE GROUPING OF CASES

The cases can be conveniently arranged in the following groups:

I Primary injuries of the chest wall

II Penetrating wounds with retained foreign bodies in the pleura or lung

III Infected hemothorax with or without retained foreign bodies

IV Through and through wounds with impairment of movement and expansion

V Injuries involving the mediastinum or diaphragm

Injuries involving the heart and pericardium are so infrequent that they are merely mentioned for completeness.

## THE INVESTIGATION OF CASES

Every chest casualty arriving at the base requires to be as carefully investigated as any other type of wound. The symptoms have often changed since the last note and the X-ray findings made nearer the front constantly require revision as the absorption of blood alters the shadow. The most important and useful method of examination is by the fluorescent screen for it shows so well the dark shadow due to blood in the pleura, the outline of the lung and of the diaphragm and the movement of both while comparison with the sound side furnishes an admirable standard. If a foreign body is present its position, movement on respiration and rela-

tion to heart beats can all be determined. Localization should be by the simplest methods and the surgeon himself should verify the findings remembering that it is really more important to have accurate localization of the foreign bodies in the parietics than in the lung for in the latter case when the chest is opened a wide area may readily be palpated. We especially want some method which will give us information as to the presence and the extent of adhesion. On the operating table I have made use of a simple plan which has proved useful. A straight needle three inches long is thrust into the lung and its excursion noted. In the absence of adhesion this follows in up and down line for one half to one inch with each respiration but in other circumstances movement is absent or much limited. I have never found portions of cloth or metallic debris in the sputum. Fluid from the pleural cavity must be subjected to microscopical and bacteriological examination but the temperature chart and pulse ratio will often give an indication of a low grade infection when no fluid is to be obtained.

## THE FEATURES OF THE VARIOUS GROUPS

### I PRIMARY INJURIES OF CHEST WALL

These injuries are caused by fragments of shell or bullets or secondary missiles. Their principal interest lies in the fact that they are so commonly entirely left alone on the assumption that the wounds are penetrating and therefore not demanding interference and because for one reason or another they are so often allowed to lead to months of disability. The patients often complain of soreness or tenderness when lying on the affected side or whenever they are called upon to exert themselves. Injuries of the rib with foreign bodies or sequestra are a common cause of sinuses on the chest wall. They may also be associated with sinuses on the upper arm about the shoulder at the root of the neck or on the abdominal wall. Their origin is not likely to be overlooked if it is constantly borne in mind that a sinus is not a disease but a symptom the cause of which must be discovered. Sometimes men who only harbor foreign bodies in the parietics complain of

shortness of breath or of pain on respiration and may present some limitation of movement of the side. Under these circumstances it must be remembered that there may be concomitant injury to the lung and this is borne out by the frequent history of blood spitting at the time of the casualty and by the findings at operation and postmortem examination. Whenever there is the least suspicion screen examination must be employed. Bullets and shell fragments have a wonderful knack of lodging snugly in an intercostal space or becoming actually imbedded in the rib and unless this latter point is remembered a useless search may be made for what is correctly looked upon as a comparatively superficial foreign body.

Osteomyelitis of the rib is not an infrequent result of an infected wound of the parietics and the multiple sequestra which may result can best be dealt with by excision of practically the whole of the affected rib. Costal cartilage readily dies and when it is necessary to interfere with it at all it is best to remove the whole of the cartilage. Gutter wounds — contour wounds — of the chest are less likely to give rise to late trouble than the other varieties because foreign bodies and bone fragments are not so often buried but on the other hand they are more often multiple. In operations for parietal injuries steps must be taken to prevent the lighting up and distribution of old sepsis for re-infection of the cut bone is very liable to occur.

### II PENETRATING WOUNDS WITH RETAINED FOREIGN BODIES IN THE PLEURA OR LUNG

This is a most interesting group for it at once raises the question of the fate of foreign bodies retained in the lung. After four years experience of war surgery I am more and more impressed with the general truth of the proposition that sooner or later a foreign body wherever situated tend to give rise to trouble. In the lung we know that many foreign bodies become safely encapsulated others are extruded into the pleural cavity usually into an already infected hemothorax or they become the nidus for a localized empyema. Possibly in some cases foreign bodies are extruded into the air passages

and are coughed up with spontaneous cure but this method must be largely limited by their size and I have never come across an example. When operating on these cases I have found small localized collections of pus in association with the foreign body the missile loosely held in an area of consolidation or a larger area of consolidation with the foreign body in its center and a purulent infiltration round about it.

In the absence of naked eye evidence of infection often no growth has followed the immersion of the foreign body in culture media and this is in keeping with the proved power of the lung to resist war wound infections. Sometimes there are shreds of cloth around the foreign body but even in these cases a singular absence of any evidence of inflammation. In no case can I say that an old infection in the lung has been lighted up by surgical interference but I have always the feeling that the pleura and the cellular tissue are less favored and may have been infected.

The symptoms of which these men complain can be arranged in two definite groups: first those with a physical basis such as pain, cough, pus spitting and hæmoptysis and second those in whom the symptoms are largely nervous. In both groups complaint of shortness of breath is invariable.

Chronic cough with intermittent slight hæmoptysis is the commonest symptom in the first group and both are much worse on exertion. The blood is usually small in amount but may be as much as three or four ounces. Sometimes these symptoms almost entirely disappear during complete rest but recurrence is the rule and I have patients which show that this sequence may continue for even two years. I must here just mention the importance of excluding tubercle which may be lighted up by lung traumatism though it is undoubtedly in frequent. Cough with pus spitting is less common and I have been surprised at the very few cases in which the expectoration suggests localized abscess or bronchiectasis. When it does occur the expectoration is characteristically foul abundant and continuous. It rapidly follows the hæmoptysis attending the

casualty and continues until the foreign body is removed. Pain is commonly referred to a localized area and often only present after exertion. Not infrequently there is tenderness over the same spot.

In the second group the nervous symptoms either occur alone or are predominant and it is amazing to find what a large number of men complain of the mere presence of the foreign body which causes them much mental misery. An analysis shows that these men dread the ultimate consequences of the presence of the foreign body and no amount of assurance relieves their anxiety. At first I used to think that it was perhaps because they feared further military service but the increasing numbers of pensioners who come for relief has altered my view. It was this latter group which first made me seriously consider the advisability of operative interference because I saw so many men who lived a life of apprehensive misery consisting of short periods in and out of the hospital.

The correct interpretation of the shortness of breath is difficult and I cannot help thinking that it is not entirely mechanical. Old hæmothorax with thickened pleura and marked shrinkage of the side adhesions with little evidence of shrinkage and interstitial changes in the lung resulting from the traumatism inflicted when the foreign body lodged may all be causative factors but in addition there seems to be some sort of inhibition suggesting a nerve origin.

In the patients who complain of pain and tenderness I have been struck by the association of a localized area of adhesions in the track of the missile. On the other hand a general diffuse adhesion between the pleural surfaces is not attended with pain and indeed may be a means of preventing it.

The signs in this group are almost limited to those due to associated old hæmothorax and to the very valuable help derived from the examination by the fluorescent screen. Want of movement of the foreign body is not conclusive evidence that it is outside the lung for in the presence of adhesions there may be no recognizable movement when the foreign body is near the posterior border of the lung or in any part with a lung diffusely adherent.

When considering the question of surgical interference we must never forget that these patients have fortuitously recovered from what has often been a most dangerous casualty and we ought not to subject them to further risk without good reason. In intrathoracic operations there must always be an element of uncertainty and I have to regret a death which I am at a loss to explain and to admit that in some few cases the convalescence has given cause for anxiety. The very readiness of our men to submit to operation increases the responsibility and their love and faith which failure cannot quell is to me an inspiring wonder while it is a constant stimulus to increased effort on their behalf.

I have now come to a position in which I would advise operation in this group if there are definite irritative symptoms leading to disability or continued discomfort and in which I would be willing to undertake operation if the removal of the foreign body would rid the patient of an incubus preying on his mind detrimentally. Unless symptoms are very definite I would hesitate to operate when localization shows the foreign body in or near the hilus for experience has taught me that it is often difficult or even impossible to distinguish a perforation between a small foreign body and a branch of the calcareous glands which are so frequent in this situation. It may be well worth while to open the thorax and to deal with some brand of offending adhesion even though anatomical considerations and prudence forbid any search for the foreign body.

*The method of approach.* There are two definite plans for approaching the lung. The first consists in excising or displacing the anterior part of the fourth rib and opening the thorax. The space gained is then enlarged by the use of the rib separator so that either the lung can be withdrawn or the hand introduced and the foreign body dealt with *in situ*. This method has the able advocacy of Major General Sir Berkeley Moynihan and those who have witnessed his brilliant operations are much impressed by the great beauty of the technique as practiced in his hands.

The other plan aims at reaching the affected part of the lung by the most direct route that

is to say nearest the site of localization of the missile and this is the method which I have usually practiced.

*Technique.* Beyond some reliable type of rib separator and a good head light no special instruments are required. For anesthesia the intratracheal method is not essential and is often a disadvantage. I employ ordinary inhalation anesthesia with CHCl<sub>3</sub> and ether preceded by morphine and atropine. It is now established that a free pneumothorax is perfectly safe and that in most cases it is much better to work with the lung completely collapsed.

After the thorax is opened band like adhesion should be separated by the fingers or with scissors. When the foreign body is in the borders of the lung and especially the lower border the portion in which it is situated can easily be brought outside for its removal. When near the middle of the lung or in the posterior surface the missile is better removed without any attempt to withdraw the viscus. Diffuse adhesions completely shutting off the pleura need not be separated the lung being incised *in situ* over the foreign body.

Complete closure of the incision in the lung is the ideal method and when this can be carried out the pleura may be completely closed. In other circumstances I use a small tube drain which is removed in 48 hours. Secondary aspiration for fluid has never been necessary. It is an advantage that the pneumothorax should not be rapidly removed so that the incision in the lung may be sealed before it expands.

*Difficulties and complications.* It would be unfair to give the impression that the operation under consideration is invariably a simple matter. It must always be an important operation and it may be very difficult especially in deeply chested powerful men in whom respiratory movements are very vigorous. Under these circumstances air is sucked into the cellular tissues in an embarrassing manner and it may also be very difficult to steady the portion of lung which is to be incised. When the foreign body is on the inner surface of the lung the beat of the heart against the fingers may be disconcerting.

It is easy to tear into the pericardium while separating adhesions and though I have seen no harm follow it is clearly an accident to be avoided.

Surgical emphysema may be an immediate sequel but it is unusual and when it does occur is principally limited to the region of the wound though it may be widespread and I have seen it extend up into the neck and down into the scrotum. It always clears up without treatment.

Some few patients suffer considerable respiratory distress just after the operation but it is surprising how smooth convalescence usually is. There is often a little blood spitting which may continue for some days and there may be quite marked bronchitis affecting the opposite lung. Patients are often well enough to be out of bed in from ten days to a fortnight and I had one man who was up on the eleventh day and rejoined for duty on the twenty first day following the operation but the period of convalescence varies with the gravity of the condition demanding interference and where there has been much destruction of lung tissue the period may be prolonged.

**Results** Interference in these cases has been exceedingly encouraging though it will require observation over months or years to determine the final results. Some of the patients have so completely recovered as to return to duty at the front many have been allocated to home service and others have been invalided out of the army but are able to earn a livelihood with the assistance of their state pension. Some of the neurasthenic patients have relapsed but this is only in keeping with the results of operations in general on these unfortunate sufferers. As your President<sup>1</sup> says Surgery is a bad form of suggestive therapeutics but I always feel that it must give the physician a better chance to let him have his patient with such tangible sources of mental worry removed.

Though nearly all continue to complain of some shortness of breath this symptom has been greatly improved in practically every case.

D W J M Y

### III INFECTED HÆMOTHORAX WITH OR WITHOUT RETAINED FOREIGN BODIES

These cases either come to us already draining or requiring incision. They are much more serious than ordinary empyemata and often demand more drastic means for their cure. The pathology is essentially different for here we are dealing with a serous sac filled with masses of blood clots which have become infected and are slowly disintegrating and there are often sequestra and foreign bodies. Every case of draining hæmorrhax arriving from the front should be carefully X rayed and screened and if recovery is at all delayed should be explored under anæsthesia. The original opening should be enlarged by resection of several inches of one or more ribs and foreign bodies and all masses of decomposing blood clot must be thoroughly removed. The final stage should consist in a dry mopping of as much of the cavity as can be reached. Two large tubes should be used for drainage.

Quite often the temperature does not come down at once and some patients are very much upset and may suffer from vomiting and abdominal pain at first. When the temperature has remained normal four days the patients are encouraged to get up and a day or two later begin the use of blowing bottles to help expansion of the lung. Some of the later stages of these cases I have treated by Moorhof's bone filling simply using it as a plug without any attempt at secondary suture.

Cases are frequent in which cavities have not healed or have broken down but these are nearly always due to retained foreign bodies or to inadequate rib resection and they yield to thorough exploration. This should not be delayed because of negative X ray examination for the small sequestra bits of cloth etc. which may be keeping up the suppuration will not show in the presence of the obscurity caused by much thickened pleura. In these cases and in fact in all cases of gunshot wounds of the chest it is important to be alive to the possibility of concomitant injuries such as those involving the diaphragm or the neighboring viscera for operative interference may disturb the favorable progress of some such complicating condition.

Small localized empyema are very apt to be overlooked. Shortness of breath, sweating and tachycardia are very suggestive symptoms and in their presence very careful physical and screen examination should be employed. Negative exploration with the needle is not conclusive because the contents are often so much inspissated that they cannot be withdrawn in this way. Cases with sinuses require careful investigation and it must not be assumed that they are always connected with a demonstrable foreign body for I have been surprised to find that the latter was outside the cavity and fully shut off by its thick wall the sinus being due to imperfect obliteration of the cavity. Small sinuses without a demonstrable cause may be cured by the use of Beck's paste.

#### IV. THROUGH AND THROUGH WOUNDS WITH IMPAIRMENT OF MOVEMENT AND EXPANSION.

Some few men so completely recover from these injuries and are so thoroughly restored that there are no signs or symptoms by which their casualty may be recognized but in a great many recovery is very long delayed and incomplete. The invariable complaint is of varying degree of shortness of breath either constantly present or set up by the least exertion. When such cases are investigated by ordinary methods they may only show a little general retraction of the affected side with corresponding diminution in air entry and breath sound but screen examination may furnish most valuable information.

There is often an obvious shadow or a general mottling due to an unabsorbed hemothorax while the edge of the retracted lung may be outlined as a well defined dark line. The diaphragm is often flattened higher than its fellow and shows limited movement or there may be obliteration of the costodiaphragmatic angle the diaphragm being pulled up to the chest wall so that its upper surface is like an inclined plane instead of a dome. These conditions are constantly found after infected hemothorax but the revelation is often surprising in the absence of infection. In other cases the shrinking and flattening is entirely limited to the lower part of the thorax particularly well marked if the left side is

affected. The lower ribs may be almost concave. The great shrinking may be present in the absence of any evidence of unabsorbed hemothorax. As in the last group it is necessary to be constantly on the lookout for localized empyema of low grade infection.

The foreign body having traversed the lung is often lodged in the parietes or in some more distant part. As a rule it is not difficult to locate and to remove such foreign body and this may bring a certain amount of mental relief but the symptoms are due to the damage caused to the thoracic contents and it is futile to remove the foreign body without an endeavor to cure the other symptoms.

Radicated exercises, gymnastic measures especially directed to expansion of the chest and the use of blowing bottles and other plans for expanding the lung have in my experience proved disappointing in their results but I am sure that these methods can be further developed and that much can be done by their aid. It is in this class of case that I have had some most encouraging results from thoracotomy. When there is old hemothorax mass of organizing clot can be removed. The lung will commonly be found imprisoned in a sort of sheath formed of organizing blood clot and this extends to the diaphragm interfering with its proper movement. Under these circumstances decortication is indicated.

It is most interesting to see the lung reappear from its coat of mail and to realize that it again has the chance to expand normally. In dealing with these particular cases I feel the want of an anesthetic apparatus which will easily allow of a change from ordinary inhalation anesthesia to a positive intrapulmonary pressure in order to demonstrate the capacity of the lung for expansion and enabling the thorax to be closed with the air expelled from the pleura. I believe these indications are met by the Schumacher apparatus but I have not had the opportunity of using it. In the cases in which there are only adhesions they can be separated either with the fingers or with long curved scissors. To completely liberate the lung those between the base and the diaphragm must be

thoroughly dealt with. The thorax is completely closed and its full breathing exercises as possible are carried out from the beginning. In those cases in which there has been suppurative the visceral covering is not easily separated and the underlying lung is easily torn. To meet this difficulty a series of longitudinal incisions with or without cross cuts appears to allow enough room for expansion. The results in a limited number of cases have been surprisingly good.

Many of the cases which we have just been considering have been repeatedly aspirated for hemothorax and there can be no question that recovery after this method frequently stops short of complete success. I have often wondered if a more thorough emptying of the pleura by thoracotomy at the time of the casualty would not lead to a greater proportion of complete cures.

#### VI INJURIES INVOLVING THE MEDIASTINUM OR DIAPHRAGM

In this group are collected the cases in which foreign bodies in the mediastinum are associated with injuries of the lungs and pleura or in which the casualty has primarily involved the mediastinum only. Small foreign bodies may be safely imbedded and without symptoms or they may lie on the trachea or bronchi and give rise to dyspnoea or to cough and sense of suffocation. Larger foreign bodies are likely to be associated either with persistent sinuses or with recurring breaking down of the wound. As a rule they can be safely reached anywhere in the anterior mediastinum by a lateral approach after removal or displacement of one or more costal cartilages.

In all cases with sinuses wherever situated care must be taken to explore and to clear the track itself for sequestra and bits of cloth are so likely to lie there where they are certain to cause mischief even after the successful removal of the foreign body. Foreign bodies embedded in the pericardium are not un-

common and I have removed them from both the anterior and the posterior surface of the sac.

When in the diaphragm foreign bodies may be associated with symptoms which suggest a casual relationship though I believe that such symptoms are more likely to be due to damage produced during transit of the chest.

#### SUMMARY

For the sake of clearness I would like to recapitulate what I consider to be the indications for operation in these late cases.

1 Foreign bodies in the parietes with or without sinuses

2 Foreign bodies in the lung irrespective of size if associated with persistent cough hemorrhage or suppuration

3 Large foreign bodies in the lung even if the symptoms are purely nervous

4 All foreign bodies lodged in the pleura with or without empyema

5 All cases of infected hemothorax

6 All cases of through and through wounds with shrinking of the side lessened lung expansion and interference with movements of the diaphragm in which treatment by exercises etc. has failed.

The object of this paper has been to draw attention to what I conceive to be a neglected group of cases and to suggest that the later stages of gunshot wounds of the chest not only form important subjects for study but offer a large field for restorative surgery in which the rewards are commensurate with the risks.

On going through my notes I find many cases that I now feel would have been benefited by operation for as in all other branches of surgical enterprise increasing experience brings increasing confidence and a desire to extend the benefits of operation.

The success of thoracic surgery in this war is a pleasing recognition of the importance of general surgical principles in military surgery for which so many of us have contended.



THE EARLY TREATMENT OF WAR WOUNDS<sup>1</sup>

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**I**N the British service the Casualty Clearing Station is the most advanced unit in which efficient hospitalization can be given to the wounded. In the early days of the war it was not contemplated that much surgery should be done in the units which as their name implied were intended as centers for the evacuation of wounded to the base where the surgery was to be done.

Experience has shown that this was a mistake for the sooner a man can be operated upon and his wound excised and cleaned the better the result. The natural sequence has been the development of the Casualty Clearing Station to be an important surgical center.

In order to make things clear let me describe quite briefly the position and constitution of a Casualty Clearing Station. The hospital is placed usually from six to ten miles behind the firing line so as to be out of danger of all but long range gunfire. It is always adjacent to a railroad up to which ambulance trains can come to evacuate the patients to the base.

The medical staff consists of a commanding officer and six medical officers with from ten to fifteen trained nursing sisters. This staff may be augmented by surgical teams sent from other parts of the army so that during a battle twelve or fifteen teams may be at work.

The essential medical elements of a Casualty Clearing Station are

- 1 Reception ward
- 2 Dressing room
- 3 Pre operation ward
- 4 Resuscitation ward
- 5 X ray room
- 6 Operating theater
- 7 Postoperative wards
- 8 Acute medical ward
- 9 Evacuation wards

The patients are accommodated in tents, huts or buildings according to the position and character of the fighting and material available.

*Reception ward* Here the wounded are off loaded from the ambulance cars and the clerks take the particulars from which the casualty lists are compiled.

*Dressing ward* From the reception ward the men go into the dressing ward through which every single patient is passed and where the future course and treatment of each patient is decided. This is what the French term *triage* and we call reception or sorting. It is most important work requiring sound experience and cool rapid judgment.

Here orderlies cut down the dressings exposing the wound ready for the officer in charge to make his examination. This officer looks at the field medical card, notes the entry of gunshot wound of buttock or gunshot wound of thigh with fracture of femur. He assures himself that antitetanic serum has been given and noted and then he examines the nature and extent of the wound and the physical condition of the patient and makes his diagnosis.

He has now to decide what shall be done and the following courses are open: (1) A man with a trifling wound may be returned to duty. (2) A man with a wound not requiring operation but yet incapacitating him from duty is dressed and sent straight to the evacuation ward to go away by the next train. (3) Patients requiring operation are sent to the pre operation ward if necessary via the X ray room. (4) Very seriously wounded suffering from shock or loss of blood who owing to their condition are unfit to stand immediate operation are sent to the resuscitation ward.

The officer in charge of the reception department must be very familiar with the working of his hospital and have full knowledge of the capacity and number of the surgeons for during times of stress it is useless to send more cases for operation than the surgeons can deal with. It becomes his duty to estimate the number of operations that can be done select

those cases that are most suitable or most urgent and evacuate the others to the base.

*Pre operation ward* Here cases are made ready for the operating theater. Strippers are at work taking off the mud caked and blood soaked clothes, washing the patients and putting them into pajamas.

*Resuscitation ward* In this ward are gathered the wounded who from cold, fatigue, loss of blood or shock are unfit for operation. It is a pitiable and heartrending sight on which it does not do to dwell. Better is it to grip the spirit of a motto which appeared over the entrance of one of these wards: *Dum spiro — cheerio*. Active bodies of men have been working on the shock problem. Much has been done already to bring apparently hopeless cases back to life and more is being done day by day, now that transfusion of blood is coming into general use. This is largely owing to the influence of the American surgeons who came to supply our need and earn our love, gratitude and admiration working with us and for us in our hospitals.

*Operating theater* These are not the beautiful marble palaces we contrived in civil practice. During mobile warfare they are in tents with meagre furnishings. The average theater contains eight tables and is so arranged that each surgical team is self contained with its own sisters, orderlies and instruments, all arrangements being designed to promote rapid and efficient work.

*Postoperative wards* In these are gathered those patients who from the severity of wounds or nature of operation are considered unfit to travel. These wards are equipped with beds and made as comfortable as possible.

*Treatment of wounds* During the four years of war so much has been written on the treatment of wounds so many methods have been advanced, lauded to the skies and practiced for a time only to be discarded that it is difficult to remember them all. I discuss them intelligently or give credit where credit is due. For this reason I propose only to tell you what I myself now believe to be the best treatment, realizing that many surgeons differ from me and knowing full well that excellent results may be obtained by many different methods.

*The basis of all successful treatment of wounds is early mechanical cleansing by surgical operation conducted under aseptic precautions.* By this is meant the removal of all dead or damaged tissue together with all foreign bodies such as the missile portions of clothing or splinters of wood. If this is done and is followed by closure of the wound either immediately by primary suture or a few days later by delayed primary suture, then a very large percentage of wounds heal by first intention with a resultant saving of a great many lives and an immense reduction in the period of convalescence, labor of medical officers and of dressing material.

Excision and suture have caused quite a revolution in the general treatment of gunshot wounds.

*Antiseptics* Little has been said in this paper about antiseptics, the reason being that it is my firm conviction that they are of little importance. The important thing is that a wound should be subjected to a complete early mechanical cleansing *before organisms have time to multiply and invade tissues*. If this is done it matters little whether a wound is swabbed with ether, flushed with Carrel Dakin solution, smeared with bipp paste or packed with flouine. As long as the wound is cleansed mechanically and no more organisms put in, then the wound will remain clean and may be closed at an early date.

An interesting experiment was made during last winter. One entire Casualty Clearing Station was set apart for the purpose of ascertaining the possibility of excising and suturing wounds on a large scale. Previous to this it was well known that many wounds had been excised and sutured successfully. It was the routine treatment to excise and suture the scalp in head wounds, it was the same for wounds of the knee joint, of the abdomen and more latterly of the chest. It had never been demonstrated, however, that the method could be applied on a large scale to all manner of wounds.

The experiment was conducted on the following lines. A bacteriological examination was made of every wound selected for the purpose. It was found that the large majority

were infected and most of them with a great variety of organisms both aerobic and anaerobic. The patient was then sent for surgical treatment. There were three sets of surgeons and each of the three sets treated the wounded in three different ways. In each case the wound was first excised and then it was treated with either saline or ether or bipp paste.

The results by all methods were extraordinarily good. Primary union was obtained in over 80 per cent of the cases among which were many compound fractures. Between the three methods used there was very little choice to be made. It is true that some surgeons leaned more to one method than the other but the main fact that stood out clearly was that the central treatment consisted in early complete mechanical cleaning of the wound followed by early closure.

This method is described by some as a surgical revolution. Of course it is not; it is rather a return to sanity. We have been blinded by the advocacy of all sorts of antiseptics which in time led into wounds were supposed to kill off all organisms.

The following facts have emerged from this experiment:

1. Over 80 per cent of the wounds treated by excision and suture healed by first intention.

2. Gas gangrene, one of our great bugs, bears in the early years of the war no longer to be feared, provided that early and efficient surgery can be rendered.

3. The most dangerous organism to the patient and the one that defeats our efforts up to the present is the hemolytic streptococcus. Primary suture failed in practically every case infected with this organism.

4. Patients whose wounds had been excised and sutured at once, if put on the train and sent down to the base did badly. The reason appears to be that the operative treatment does not get rid of all organisms and though the tissues are capable of dealing with them if conditions are favorable, the commotion and shaking of the train causes a little fresh bleeding and provides the remaining organisms with conditions favorable for their growth.

The result was the establishment of the following routine. If a wound is excised and sutured, the patient is kept in the hospital under the care of his surgeon until all risk of suppuration is over. During quiet times it is possible to return such cases in the casualty clearing stations but in busy times in times of battle the holding capacity of these hospitals is not nearly enough; they must be cleared.

To meet this difficulty the following practice has been evolved. At the casualty clearing station the wound is cleansed by excision. It is then lightly picked with either dry gauze or gauze soaked in flavine or paraffin. The patient is then sent down to the base, having attached to him a distinctive label for Delayed Primary Suture. At the base the patient is taken to the theater, placed under anesthetic and the wound if considered suitable is then sutured. Following this plan thousands of wounds have been sutured this year.

This delayed primary suture, or *suture primitive retardée* as the French term it has shown itself even more successful than the primary suture for the reason that if a case is going to go wrong from infection with the hemolytic streptococcus it will do so early and such a case will be reserved for secondary suture.

*Favorable time for operation.* The best time is as soon as possible provided that the patient can stand the operation. The average time between receipt of the wound and arrival at the casualty clearing station is twelve to eighteen hours and wounds excised about this time usually do well. It has been shown though that a wound can be excised and sutured successfully even up to and after forty-eight hours.

*Technique.* There is nothing difficult or complicated about this cleanliness and care are the requisites. The essential is to remove every scrap of dead or badly injured tissue and every foreign body whether a bit of shell splinter or cloth. In order to make a complete removal of all dead tissue it is necessary to expose every recess and corner of the wound. This often involves a long incision which should be planned to allow of

free exposure and subsequent closure. This closure of the wound is often difficult on account of loss of substance and calls for ingenuity on the part of the surgeon. Much may be done by undercutting and insertion of deep tension sutures. Drainage tubes are in disfavor. As a rule they do not drain and act only as foreign bodies. Considerable use is made of filiform drains, a few strands of fishing gut or a bit of pewter wire giving sufficient room for the exit of any collected serum.

After suture rest is necessary, but it must always be borne in mind that the object of the surgeon is not only to get union of his wound, he desires to *establish restoration of function*. It is likely that we have been too conservative in our methods and have rested limbs and fixed joints for too long a time, giving rise to all sorts of contractures. It is my belief that after closure very few wounds other than fractures require splinting for more than two or three days. The patient himself is the best judge; he will never hurt himself by movement and it is a safe rule to allow movement up to the limit of the patient's toleration.

The psychological side of the soldier is worth studying too. He is much more likely to get well quickly if allowed to move about and be encouraged to move about at an early date. These remarks apply to every type of wound, whether of the soft parts of the abdomen or of the chest or skull. The earlier, more careful, and more complete the surgery, the better the result. That is the reason why Casualty Clearing Stations have become important surgical centers. In other words, the surgeons are taken to the wounded and not the wounded to the surgeon.

*The lightly wounded men.* The previous remarks have related rather to the seriously wounded to whom all our humanitarian instinct goes out. It is only right and proper that all our efforts should go to succor them and save their lives and limbs. From a military standpoint from the standpoint of reducing wastage of man power, which in the long run is also humanitarian, the treatment of the lightly wounded men is of the greatest importance. In the past there has been rather a tendency to neglect these men as not re-

quiring urgent operation. During a battle they arrive at the Casualty Clearing Station in large numbers. Supposing for instance that during a battle one thousand wounded arrive at a Casualty Clearing Station, roughly six hundred will be walking wounded and four hundred stretcher cases. The walking wounded suffer from all variety of wounds from light scratches to moderately severe injuries with or without retention of foreign body. Naturally when there are many more wounded than can be dealt with the irresistible tendency is to treat those cases most in need of treatment; life saving must come first. Therefore the lightly wounded must be evacuated and they go to the base as quickly as they can be got away by the train. If these cases are not treated at the base many of them suppurate and a man with a small almost negligible wound may be incapacitated for two or three months or more.

To remedy this we have recently organized large hospitals at the base to which the lightly wounded are sent as quickly as possible. These hospitals are organized to get as many surgeons as possible into action at once and all efforts made to pass as many wounded as possible through the operating theater before the wounds suppurate. Here the wounds are excised and sutured. The results have been most happy in our particular hospital during recent fighting; they had 90 per cent of success from suture under these conditions. One of the hospitals was under the direction of Colonel George Crile to whose brilliant inspiration we owe much. Colonel Crile made some very interesting and important observations. He made composite temperature charts from patients whose wounds had been excised, treated with ether, alcohol, saline solution, flavine or bipp paste. The best temperature charts were obtained from those patients whose wounds had been treated with saline only.

*Battle technique.* It has been suggested a battle technique should be developed that instead of doing good surgery for a comparatively small number of men, a larger quantity of unfinished surgery should be done. In my opinion this is absolutely wrong. As it is, it is hard enough during battle to

maintain a high standard but let us always aim at the ideal

The main principles of surgery are as true in war surgery as in civil practice. The great advances which surely have been made in war surgery are not due to the discovery of any new principles but are due to the development of a medical organization which permits the application of surgery near the front and

enables surgeons to treat the wounds before infecting organisms have time to invade the tissues

It is the aim of this paper to speed the coming of that ideal medical organization which will permit the treatment of each wounded man in such a way that suppuration will become as rare in military as in civil practice

## ACUTE PERFORATIONS OF THE ABDOMINAL VISCERA

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J. L. M. D. I. C. p. L. 15, 1894

THIS is a certainurgical philosophy which not only interprets disease condition from the clinical and pathological standpoint but also endeavors to arrange facts in orderly array to follow the natural history of the disease and its relations to other disease processes of which it either is a part or with which it may become associated as a cause or an effect. Such philosophy does not follow a direct pathway textbook fashion but strive rather to secure a perspective of the various pathological conditions which knowledge of disease in general has advanced its ultimate goal is the full exploration of the breadth as well as the length of the road. In this manner I believe we may acquire wisdom.

Our knowledge of acute perforations of the abdominal viscera had its origin largely in perforative appendicitis although the first perforations studied were those of the stomach. To the late Edmund Fitz of Boston we owe our earliest organized knowledge of three most important surgical conditions. The relation of appendicitis to general peritonitis of perforation of the pancreas to fat necrosis and of the diverticulum of Meckel its infection and perforations its frequent occurrence in the young and the ironing out process of development and gas pressure by which Meckel's diverticulum becomes less evident in the old. The work of Fitz was done largely postmortem. His investigations connected cause with effect but as they began in

the dead and ended in the grave an exaggerated notion of the fatality of acute perforations in general was obtained. The evidences of perforations were almost lost in the peritonitis which ensued and which caused the death of the patient. In speaking of acute perforations we visualized the dead man with a general acute peritonitis.

The slow process of developing a living pathology was taken up by the surgeon and little by little the ravages of the fatal septic peritonitis were separated from the cause. We began to see that not all perforations ended fatally and that many factors came into play which might permit of spontaneous recovery from any particular perforation. These factors concerned the quantity and virulence of the leakage from the perforation, organ, the general resistance of the patient and the local anatomic situation of the perforation with relation to the prospects of limiting by adhesions the spread of the contamination and resulting peritonitis. The mechanical relations of the perforated viscus to the omentum, colon and other peritoneal covered organs as well as to the abdominal wall which would permit of barricades against further spreading and especially those mechanical factors which prevent continuation of the small intestine with its peristalsis received merited attention. The dictum that cathartics kill the patient with acute perforation was generally accepted. The fact

that restriction in diet the washing out of the stomach and water by rectum lessened the danger of the spreading of contamination and infection by peristalsis was established by Ochsner and Murphy. Even the most conservative surgeon began to wake up to the fact that after contamination had passed into peritonitis the most important factor was the peritonitis and that the so called early operation was not related in time to when the surgeon saw the patient but to the time when the perforation took place. How well we remember those great debates on appendicitis when the surgeon in the heat of argument said that he always did so and so when he meant often and the safety of his patient depended on the fact that he was a better surgeon at the operating table than on the rostrum. When contamination was allowed to pass on to peritonitis the surgeon had lost his great opportunity and the second dictum was reached. If you must operate in peritonitis for a local lesion get in quick and get out quicker choosing a time when intervention can be safely made rather than to bring a surgical catastrophe on a patient who has only a narrow margin of safety. We learned that the peritoneum had marvelous powers of resistance to infection and that the surgeon could act only in the capacity of an aid to those natural processes which led to recovery.

It can no longer be said that we are operating for perforation when we do a laparotomy on from the third to the sixth day of a generalized peritonitis. An operation however may be wise in order to remove a still active primary focus or secondary deposits of virulent infection in the hope of limiting the spread of the disease. Acute perforations of the abdominal viscera then so far as the peritoneum is concerned may be divided into three stages. (1) The stage of contamination shown by more or less shock and localized pain and tenderness. This is followed by (2) the stage of reaction we might well say the fatal stage of reaction because so many patients with acute perforations slip by the stage of contamination in which they could have been safely operated on into (3) the stage of general peritonitis. The apparent improvement which takes place in the period

of reaction leads to the belief that the patient is better. Muscular rigidity and tenderness are usually present but may be absent in the middle aged fleshy man whose peritoneum has become anæsthetic by reason of fat deposited behind it.

The anatomic situation of the appendix is such that the prospects of the localization of the sepsis and spontaneous recovery are usually good. Recovery yes from that particular attack. It is probable that not far from 70 per cent of patients with acute perforation of the appendix might recover from one attack spontaneously but a death rate of 30 per cent is a frightful one. No battles of the present war would probably have a death rate which would exceed it although they might have a casualty of 90 per cent. In acute perforative appendicitis we have a casualty of 100 per cent and let us accept as probable a 30 per cent death rate. But such patients recovering spontaneously cannot be said to be well. The majority will have future attacks in one of which they may not be so fortunate as in the first. I have seen several patients more than 60 years of age with acute intestinal obstruction from bands of adhesions that had their origin in a so called spontaneous recovery from inflammation of the bowels when a child.

There is a curious relationship between acute perforations of the gall bladder into the free peritoneal cavity and acute perforative appendicitis. I have seen a number of simultaneous perforations of the gall bladder and appendix. In these cases the gall bladder has usually contained stones the pus has had a strong colon odor and its bacterial flora has been similar to that in the pus escaping from the appendix. The first case of this kind under my observation resulted most unfortunately as the condition of the appendix escaped attention. The gall bladder had perforated and a beginning septic peritonitis with a good deal of turbid fluid was present. The patient had been ill with acute symptoms for more than 72 hours. I therefore removed the stones as quickly as possible drained the gall bladder and evacuated the fluid contents of the abdomen made a rapid toilet and inserted drains. The patient died 48 hours

later when I found that there had been a perforation of the appendix with an abscess imperfectly walled off into which a fecal concretion had escaped. Had I discovered the true condition of the appendix at the time of operation there is little doubt that the patient would have recovered. Since that time I have always examined the appendix in cases of acute perforations of the gall bladder and in a number of instances have seen similar condition. It would appear that in such cases the infection started in the appendix and was carried through the portal circulation to the gall bladder already infected and containing stones.

Perforation of the gall bladder into the free peritoneal cavity should and would give the best result of any were it not for the fact that the patient has usually had previous attacks of cholecystitis and believe the present attack is similar to those that he has had before. Early operation therefore in such acute perforation of the gall bladder are liable to be insisted on and the patient dies not because of the nature or character of the infection but because of the future with which operative procedure is carried out.

Infection reaching the liver by way of the portal circulation is much attenuated by the action of the liver cells and the escape of septic material from the gall bladder and bile ducts has a tendency to set up rather mild peritonitis. On several occasions I have found a perforated gall bladder with escaping gall stones and beginning peritonitis. In two instances I have removed hundred of tons by scooping them and the fluid exudate out of the pelvis with the gloved hand and finally stopped without suturing myself that I had actually removed all the tons. Such patients operated on in the first 48 hours have recovered.

The anatomic surroundings of the gall bladder are excellent from the standpoint of protection. The parietal peritoneum the under surface of the liver the transverse colon and the omentum all combine to localize the contaminating material which may escape from the perforation. Free perforation therefore while it often takes place is commonly limited by a rapid protective peritonitis with

plastic exudate confined to the immediate vicinity of the gall bladder.

Gall stones are foreign bodies. While they may remain for long periods of time without evidence of active infection they are a potential source of focal infection in the production of endocarditis etc. and when acutely infected are the common cause of biliary cirrhosis chronic pancreatitis etc. We have found a higher percentage of so called essential hypertension in connection with gall tone disease than in any other surgical disorder with which we have come in contact.

The association between the diseases of the gall bladder and biliary tract and the pancreas is shown by the fact that 90 per cent or more of all the patients having acute and chronic disease of the pancreas that we have operated on have had infected gall bladders and usually gall tones. To all intents and purpose acute fat necrosis and hemorrhagic pancreatitis are the results of perforation of the pancreas and the escape of its secretions. The area of distribution of escaping contents from the pancreas is determined by the fetal pancreas rather than by the adult anatomy. The pancreas in fetal life is entirely surrounded by peritoneum the posterior layer of which in the adult has become converted into connective tissue with the formation of the capsule.

The danger of the acute processes of the pancreas which may be spoken of pictorially as acute perforation depend almost entirely on whether or not infection coexists. I have seen aseptic fat necrosis with a large soft pancreas almost like pudding in a bag and acute and subacute pancreatitis in every phase from the earliest with free peritoneal fluid and most widespread fat necrosis through all the stages to spontaneous recovery which is a not infrequent termination. This is also true of the pancreatic apoplexies which cause hemorrhagic cysts. I have seen a considerable number of the aseptic localized collections of blood in and about the pancreas. The patient gives a history as in fat necrosis of a most serious acute illness which gradually subsides and leaves hemorrhagic residue. It is said that activation of the pancreatic juice by the duodenal secretions is necessary to

precipitate pancreatitis with fat necrosis or hæmorrhage. Infection certainly plays the chief part in determining whether or not the patient will recover. At various times I have opened abscess cavities connected with the pancreas and on several occasions have lifted out a slough which apparently represented the whole of the pancreas but the recovery of the patient without diabetes or other sequelæ showed that not all the pancreas had been removed.

Deaver has called attention to the possibility of the infection of the pancreas through the lymphatics. The pancreas has five sources of blood supply and lymphatic connections with each. With his usual clarity of vision Deaver points out that the pancreas has two entirely different secretions, a lipolytic or fat splitting ferment which saponifies the fat producing the little areas of lipase that we call fat necrosis and trypsin which acts on the protein tissue especially the blood vessels causing the hæmorrhage. Whipple calls attention to a proteose substance which may be produced and cause rapid and fatal toxæmia. These observations explain the clinical conditions that we find in the acute forms of pancreatitis. I have been much interested in the recent work of Watts and others in regard to acute pancreatitis and the necessity for direct procedures on the acutely inflamed pancreas. Our experience, however, leads me to take rather a conservative view and to content myself with the anterior abdominal approach to the pancreas and drainage of collections septic or otherwise as they occur rather than to anticipate their occurrence by pancreatic incisions. It would appear that as a result of our early postmortem knowledge and tragic experience with an occasional acute pancreatitis we have been inclined to underestimate the ability of the tissues concerned to localize or cure a large number of the acute pancreatic inflammations.

Perforations of the duodenum into the free abdominal cavity are the most common of all types of acute perforations but fortunately the duodenal content is more or less sterile, small in quantity and has a tendency to gravitate into the region of the appendix. For this reason the preoperative diagnosis is often ap-

pendicitis and a high percentage of patients make a spontaneous recovery from that particular attack. Not infrequently the appendix is removed showing evidences of peritonitis on its surface but without disease of the mucosa and the true cause of the trouble is not discovered. The patients recover in most instances in spite of the removal of the appendix at an inopportune time and later they have a recurrence of the duodenal trouble eventually coming to operation for its cure. In nearly all of our earliest operations for acute perforations of the duodenum a negative exploration of the appendix was first made and the perforation of the duodenum was found during further exploration. It is fortunate indeed that an incision one inch to the right of the midline through the rectus muscle enables the surgeon to make a comprehensive examination of the appendix, gall bladder, pancreas, duodenum and stomach and gives him ample opportunity to do whatever is necessary without regard to the preoperative diagnosis. We have operated on perforating duodenal ulcers in almost every stage of recovery. The duodenum is unusually well situated anatomically for the formation of protective adhesions to the gall bladder, gastro-hepatic omentum, transverse colon, etc., which quickly limit the spread of the contamination and after some hours of pain from protective peritonitis there may be only muscular rigidity and localized pain to mark what was in the beginning a free perforation.

Whether or not a certain condition would be called free perforation might depend to a large extent on whether the operation is done in the first ten or twelve hours before limiting adhesions are formed or in the subacute or chronic stage when the perforation is closed by plastic lymph and the peritonitis has become limited. In a large number of cases of acute perforations in the stage of contamination or localized infection we have operated in the first eight or ten hours and recovery has nearly always occurred. The results however have been much less fortunate when the operations were done between 10 and 30 hours, a general spreading septic peritonitis quickly brings many of the patients to a condition in which an operation as a last resort



will probably be unsuccessful a number however will after 48 hours be greatly improved and operation can be done safely. When it is possible to operate on an acute free perforation in the first 10 hours not only will the perforation be closed and the contamination prevented from passing into a peritoneal infection but a gastro-enterotomy may be done which means a cure of the conditions that depend on the ulcer and that probably would not have been cured by a mere closure.

What has been said about acute perforation in chronic ulcer of the duodenum applies to ulcers of the pyloric end of the stomach and to a considerable extent to perforation of ulcers on its posterior wall. Perforation of the stomach are much less favorably situated than ulcer of the duodenum in relation to the prospects that the spread of contamination will be quickly limited by neighboring structure. The stomach often has a considerable quantity of content at the time of perforation in a more or less septic condition as contrasted with the rather sterile duodenum so that there is a greater prospect of an escape of a large amount of septic material into the area of the small intestine instead of gravitating, as from the duodenum down through Morrison's space in front of the right kidney to the iliac fossa. Ulcers of the posterior wall of the stomach frequently become adherent to the pancreas and along the lesser curvature the gastrohepatic omentum is a good protection. Anterior perforation have a high mortality unless operated on early for the reasons I have outlined. Fortunately

free perforations of the stomach are the least common of all perforations.

#### SUMMARY

1. It may be said that a considerable percentage of free perforations are spontaneously closed and that the area of peritonitis is limited through natural processes the death rate is possibly about 30 per cent but the 70 per cent of patients who may recover spontaneously from the attack are not cured.

2. An exploration through a longitudinal incision just to the right of the midline gives the surgeon an opportunity to make a careful exploration and to deal with any or all varieties of perforation.

3. Early operation that is within the first 8 hours barring accident means recovery because the stage of contamination has not yet passed on to infective peritonitis and measures may still be taken for the permanent cure of the condition which lead to the perforation.

4. Chronic conditions usually precede perforation and give ample warning of the presence before it takes place. While this is accepted so far as the appendix is concerned it has not been so generally recognized that gall stones and foreign bodies which need only infection to lead to the most widespread peritonitis cholangitis biliary cirrhosis and pancreatitis.

5. Chronic ulcer of the stomach and duodenum after a reasonable attempt has been made at medical cure should be looked on as surgical malady.

## TORSION OF THE GREAT OMENTUM DURING PREGNANCY

By J L BUBIS M D CLEVELAND OHIO

A t a t O b t t n M t S H p t l

**T**ORSION of the great omentum *per se* is considered an infrequent pathological condition only 131 cases having been reported in medical literature prior to 1914. I have found no report of its occurring during pregnancy. The following case is therefore reported.

Mrs S age 6 married two and a half years. The patient has had the usual diseases of childhood. She has never had any bowel trouble previous to her last pregnancy. Six months after her marriage she had a four months miscarriage following a fall from which recovery was uneventful. Since then her menstruation has been regular lasting three days with the usual amount of flow and accompanied by very little pain. Fifteen months later she again became pregnant.

On March 1916 examination at my office showed the following. Her heart and lungs were negative. There were no tender points on abdominal palpation and pelvic measurements showed a male type pelvis. The uterus was found enlarged to the size of a four months pregnancy. It was smooth regular movable but pushed to the right side by a distended bladder. The other classical signs of pregnancy were also present. The urine was negative and the blood pressure 110-76. She was feeling well and complained only of a slight constipation for which liquid paraffin was prescribed.

On April 5 1916 when she was about five months pregnant the patient came to my office complaining of slight abdominal distention constipation and some fullness in the right lower abdomen. Temperature pulse and respiration were normal. An enema and aromatic cascara were prescribed.

April 7 1916 She complained of an increasing tenderness just above the uterus about half way between the umbilicus and the right corner of the uterus. A milk diet rest in bed and an enema were advised.

April 8 1916 No relief was obtained from the above treatment. Temperature pulse and respiration were normal. An ice bag was then applied.

April 9 1916 The pain at the tender spot was gradually increasing. There was no nausea or vomiting. The bowels were kept open with enemata. At 4 p m her temperature and pulse had risen to 99.1 and 110 respectively and she complained of feeling sick. The abdomen was regularly distended the lower part being occupied by a five months pregnant uterus which was distinctly palpable and easily outlined. Fetal movements could be felt. No abdominal distention of the

stomach or of the intestines was demonstrated. No peristaltic movements observed.

Along the anterior upper right surface of the uterus extending almost in a straight line from above downward four small nodules could be palpated. There was slight abdominal rigidity but not in proportion to the severe pain caused by pressure on the tender spot described above. No definite mass was palpated nor was there evidence of fluid in the flanks.

An operation was advised and accepted for the following reasons: the pain temperature and pulse were increasing and delay meant increased danger to mother and fetus. Although no definite diagnosis could be made the clinical history the symptoms and progress of the case warranted an immediate exploratory examination.

The operation was performed under ether anesthesia. A right rectus incision three inches long was made at the level of the umbilicus. After incising the peritoneum a considerable amount of uncoagulated bloody fluid escaped. A thickened discolored mass slightly adherent to the posterior wall of the uterus and extending down to the cul de sac was then loosened and delivered through the incision. This proved to be the large omentum swollen edematous twisted a number of times on its long axis and gangrenous at the lower part. The veins were swollen enlarged and some contained blood clots. The whole omentum was removed close to the transverse colon after tying it off with interrupted plain catgut. A small slightly adherent firm appendix with its tip pointing upward and inward was then removed. Section showed an obliterating appendix. There was also a marked Jackson's membrane present. On the upper anterior surface of the uterus were four small fibroids ranging in size from one half to one centimeter in diameter. The abdominal incision was closed in layers without drainage and the patient was removed to her room in good condition. The convalescence was perfectly normal and the patient was out of bed at the end of two weeks.

The pregnancy progressed smoothly until July 3 1916. The membranes ruptured about noon and labor pains began within an hour. At 7 p m the cervix was completely dilated the labor pains were very strong and regular and occurring about every two minutes. The fetal head was in the R O I position. Under anesthesia the head was rotated to the R O A position and an eight months fetus was easily delivered with medium forceps. The child weighed six pounds four ounces. A normal intact placenta and membranes were expelled fifteen minutes later. The uterus contracted

firmlly and examination showed a second degree laceration of the perineal body. This was immediately repaired with No. 2 chromic catgut sutures. One irachm of the fluid extract of ergot was given when the patient awoke from the anæsthetic.

The next morning the patient complained of abdominal distention, pain and inability to void. Examination showed that uterine relaxation and extending, per the right of the margin. Vigor of the uterine muscle present. Uterine large blood clot. No occult discharges. Urine. A firm abdominal wall. No appreciable change of the fluid extract of ergot was given. No further trouble when under the influence of the drug.

July 10. A patient admitted to hospital. No labor in the uterus. The uterus could not be felt. The patient feeling very ill and suffering from abdominal pain.

**Causes.** Some of the conditions which may give rise to torsion of the omentum are tuberculous peritonitis, hernias, malignancy, appendicitis, pelvic inflammation, adhesions, hemorrhage within the abdomen (1) and accessory omentum which becomes strangulated by torsion (2). Sudden exertion, strain, increased peristalsis, forcible attempts at reduction of a hernia (3) are also mentioned as causes of this condition.

**Mechanism.** The following theories suggest possible explanation of the mechanism of this condition.

1. There may be a matting of the free extremity of the omentum into a ball which is easily rotated (8).

2. There may be a band of omentum adherent to the colon which acts as a pivot (4).

3. The omentum may be made to roll or flow by the peristaltic movements of the intestines and by the unequal degree of pressure within the abdomen caused by the transit of gas through the intestinal loops (10).

4. The omentum may act like a semi fluid body and forced by the unequal pressure passes among the abdominal contents in the line of least resistance (10).

5. The twisting may be due to the fact that the overdistended veins of the omentum wrap themselves and incidentally the omentum about the shorter and stiffer arteries (11).

6. The omentum is compared to a handkerchief folded triangularly which is fastened at two corners allowing the third to rotate (9).

**Types.** 1. Torsion of the omentum without a co-existing hernia involving only the omentum or involving other adherent abdominal structures (1).

Torsion with a pre-existing hernia when there may be (a) intra-abdominal torsion involving the hernia strangulated or infirmed (b) intra-abdominal torsion without involving the hernia (c) omental torsion within the hernial sac only (d) complicated cases in which there exists both intra-abdominal and hernial twisting of the omentum or in which either intra-abdominal or intra-hernial torsion is associated with retrograde incarceration.

The amount of congestion or anemia varies and may be accompanied by gangrene and even infection which is generally from a hematogenous source. The gangrene is due to strangulation of the blood vessels. Thrombi may also form from which emboli may be liberated and carried in the circulation to distant organs especially the lungs.

**Occurrence.** In twelve cases reported (10) torsion of the omentum occurred seven times in the male and five in the female. The average age being 36 years. In five cases the entire omentum was involved. Ten of the cases were acute, one was chronic and no mention was made of the other.

**Symptoms.** 1. Pain is a constant symptom and is generally located in the right iliac region (5). However it may also be referred to the epigastrium (7) to the posterior right kidney region to the right hip or the patient may complain of a slight uneasiness and bound down sensation in the region of the appendix (2). It may also be a constant dull aching localized pain in the lower abdomen. Neither rest in bed, bowel movements nor food have any effect on its severity.

**Bowels.** In a series of cases (6) it was found that two complained of diarrhea, sixteen were reported as having normal bowel movements, eleven were constipated and five passed flatus.

3. Nausea and vomiting. These are not constant symptoms. In the above series they were present in 35.8 per cent and absent in 26.4 per cent. When present however they were frequent and violent occasionally alternating with diarrhea (7). At times the

vomiting may even suggest obstruction of the bowels (1)

4 Temperature and pulse In the early stage before complications arise the temperature and pulse may or may not be affected The highest temperature recorded was 100 F ( ) and the highest pulse rate was 100 (6)

5 Blood pressure and examinations have no special significance Veitor's patient had 12000 white blood corpuscles of which 81 per cent were polymorphonuclear

6 Headache and backache occasionally occur (1)

7 Prostration may be present ( )

8 Flushed face was also noted by Hale

*Clinical signs* A tumor was present in all but three of the cases (6) The margins were generally ill defined and the tumor may extend from one and one half inches below the costal margin to the crest of the right ilium (10) from the right kidney to the appendix region ( ) or there may be a large swelling on the left side above the pubis attached to the uterus and palpable through the vagina (12) In one case reported (3) no mass or hernia could be felt but the whole right side of the abdomen extending to the median line was dull and flat on percussion

Abdominal distention was noted in 13.2 per cent of the cases (6) Spasm of the abdominal muscles may be present (1) Ascites is rarely demonstrated

*Diagnosis* Bookman states that purely abdominal torsion of the great omentum can not be diagnosed There are no definite symptoms until sufficient torsion has occurred to interfere with the return circulation However in the absence of a hernia the presence of a painful spot which gradually increases in severity in the right side of the abdomen the mildness of the symptoms in contradiction to the appendiceal or other serious intra abdominal conditions may point to the diagnosis If in addition to the above there is an early or sudden appearance of an abdominal tumor with indefinite margins and dull on percussion which is sensitive but not especially painful or if there is a large resistant area then a diagnosis of torsion of the omentum may be safely made

*Differential diagnosis* Some of the conditions which simulate torsion of the omentum are acute and chronic appendicitis obstruction of the bowels extra uterine pregnancy abdominal abscess kidney stones tumor of the mesentery volvulus mesenteric thrombi

*Prognosis* The prognosis is fairly good if an early operation is performed The mortality and risk increases with the delay in diagnosis and operation

*Treatment* An operation should be performed as soon as a diagnosis is made In the absence of a diagnosis it is advisable to do an exploratory operation in cases where the symptoms point to an intra abdominal condition which is getting worse

The incision is made over the most prominent part of the tumor if there is one felt or over the spot of tenderness On opening the peritoneum there is generally an escape of free fluid of variable amount and color It may vary from a serous straw colored fluid (2) to a dark blue suggesting an extra uterine hemorrhage The mass is easily palpable and can be readily separated from the surrounding tissues Hale describes a peculiar crepitant sensation which is felt when breaking up the light adhesions In Veitor's case the mass was blue black in color and contained numerous pulsating arteries and was twisted from right to left eight or nine times In neglected cases necrosis or gangrene of the omentum will be found It is best to remove the omentum close to the transverse colon so as to prevent the extension of thrombi or the formation of abscesses of the omentum (3) The appendix should be removed at the same time and the abdomen closed in layers without drainage unless infection is present

*Complications* Infections adhesions thrombi and emboli are the most common complications During pregnancy the expulsion of the fetus may occur

#### COMMENT

There have been very few cases of intra abdominal torsion of the omentum without a co existing hernia I have been unable to find any record of a successful operation for this condition during pregnancy

The primary cause of the torsion of the great omentum in this case was probably an adhesion of the tip of the omentum to the cul de sac. The pressure from the growing uterus and the peristaltic action of the intestines together with the congestion of the veins of the great omentum were undoubtedly secondary causes of this condition. When the vein of the omentum becomes enlarged and swollen they tend to wrap themselves and incidentally the omentum about the shorter and tiffer arteries (11).

A localized point of tenderness, normal temperature, pulse and respiration and the absence of nausea and vomiting in the early

stages of pregnancy are a group of symptoms very suggestive of torsion of the great omentum.

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## DUODENECTOMY—ITS EFFECT UPON THE LIFE OF AN ANIMAL

## TRANSPLANTATION OF THE PANCREATIC DUCT

By PANCREATIC DUCT TRANSPLANTATION. By I. R. E.  
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UNLIKE the stomach jejunum ileum and colon the duodenum has long been regarded as a most important organ in the human economy. Before the dawn of the modern surgical era this view probably was fostered by the anatomical knowledge that the great digestive gland, the pancreas and the liver discharge their respective secretions into this segment of the intestinal tract. More recently the shocking death rate attending the extirpation of duodenal cancers has worked to elicit respect for this organ even from the surgeon.

Perhaps the greatest interest, however, was awakened in regard to the functions of the duodenum when Ilseger linked this organ with the pancreas in his neurogenic theory of diabetes. Ilseger and his school it will be recalled contended even up to the former's death that a nerve mechanism in the wall of the duodenum governs the activity of the pancreas in so far as its antidiabetic function is concerned and accordingly that extirpa-

tion of the duodenum causes diabetes. The conception of course lost recognition when Minkowski in 1907 exhibited a dog apparently in good health with full carbohydrate tolerance from which the duodenum (to either with the greater portion of the pancreas) had been extirpated four weeks previously. Subsequent to the demonstration the animal was again operated upon to remove the remaining fragment of pancreas. Five hours later sugar appeared in the urine and the dog became diabetic.

Ilseger's experiment then have served not only to demonstrate the absence of a duodenal control over the antidiabetic function of the pancreas but also to lend our conception of the importance of the duodenum in the life of an animal. They do not however warrant any conclusion being drawn as to the remote effects of duodenectomy. Whether a duodenectomized animal will succumb in the course of a few months from inanition or other disturbances has remained an unsettled

question and subsequent studies in this field have failed to settle the matter

The reason for this becomes more or less obvious when one considers the anatomical relationships of the duodenum and the pancreas in the dog. The ducts of the pancreas emerge from the main portion of the gland which lies closely approximated to the duodenum. The pancreaticoduodenal vessels lie between the two organs. When the duodenum is resected not only is the blood supply of the pancreas greatly affected but the ducts are severed as well. It is these conditions which have made it necessary—in all of the experiments recorded—to extirpate the greater portion of the pancreas along with the segment of intestine.

The problem connected with the biliary tract has been met successfully by diverting the bile into the intestine (cholecystenterostomy). The problem of pancreatic digestion on the other hand still awaits solution since in Pflueger's experiments and in those subsequently recorded the supply of pancreatic juice had been withdrawn permanently from the intestines.

In order to determine then whether the presence of the duodenum is essential to the continued good health of a dog it will be necessary to devise a surgical technique by means of which (1) the pancreas may be left intact with an unimpaired blood supply and (2) the pancreatic secretion may be discharged into the digestive tract. It is with these problems that the experiments detailed in this report are concerned.

In the course of some work<sup>1</sup> having to do with the effects of pancreatic juice upon the level of gastric acidity the major pancreatic duct with a small segment of neighboring duodenum was successfully transplanted into the gastric wall. As the study progressed it became desirable to resect the greater portion of the duodenum in order that the pancreas might be left with but one channel of communication with the digestive tract, namely the major duct opening into the stomach. A review of the literature however revealed no investigations in which these experimental

conditions had been met. From these considerations it is evident how what at first appeared to be merely a subsidiary phase of the work on gastric acidity subsequently developed into a separate problem.

#### LITERATURE

In 1907 Minkowski<sup>2</sup> extirpated the entire duodenum. This was the first successful duodenectomy experiment recorded. Together with the duodenum Minkowski excised the greater part of the pancreas, that is the main body of the gland including the pancreatic ducts which lies adjacent to the intestine. The bile stream was diverted into the jejunum by means of a cholecystenterostomy. A gastroenterostomy re-established the channel of communication between the stomach and the upper intestine. Subsequent to the operation the dog was lively and displayed a marked voraciousness. Sugar appeared in the urine only in the specimens secured immediately after the operation. A rich carbohydrate diet later led to no glycosuria. As mentioned in a preceding paragraph the dog was observed under these conditions for but four weeks as this was regarded as a sufficient interval to establish Minkowski's contention that extirpation of the duodenum does not lead to the development of the diabetic state.

Bickel<sup>3</sup> in 1909 reported the successful extirpation of the duodenum in two dogs, one of which survived for 10 days and the other for a period of 4½ weeks. In these experiments the pylorus was closed and a gastroenterostomy performed. The common opening of the ductus choledochus and the major pancreatic duct were sewed into the skin. As it is practically impossible to carry out the latter procedure without preserving some of the mucosa adjacent to the papilla of Vater it is questionable whether Bickel's experiments should be accepted as representing complete duodenectomies.

Bickel refers to some studies of Katzenstein carried out in his laboratory which indicate that the duodenal mucosa when it is sutured into the gastric wall is al-

<sup>1</sup> G. Y. Th. d. r. s. (th. p. re. t.) (m. th. d. od. m. t.)  
th. t. m. h. t. d. t. p. th. l. l. g. d. t. y. d. p. the  
p. J. L. p. M. d. 97 vi 85

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ways digested even in the presence of a good blood supply. To these findings I must take exception since in some experiments the results of which have already been published<sup>1</sup> I noted duodenal transplants in the wall of the stomach in a healthy state of preservation many months subsequent to the operation. Mann apparently has had much the same experience with jejunal transplant.

In his report of his experimental work in the upper intestine in 1910 Matthew makes the statement that total extirpation of the duodenum is incompatible with life longer than a hour. Matthew it would appear was not familiar with the classical experiment of Minckwitz. His findings nevertheless serve to emphasize the difficulties which one encounters in attempting resection of the portion of the intestinal tract.

In 1911 Stone, Bernheim and Whipple reported the results of some investigations with blood transfusion. The duodenum was divided just distal to the entrance of the major pancreatic duct and again at the beginning of the jejunum. The offered intestinal loop from a rat 1 centimeter in length from a number of dogs, which loop was resected. Of the latter group one animal lived for a period of 5 weeks. The investigators concluded from this experiment that the part of the digestive tract included in the loop is not essential to life.

Stassoff in 1914 published some interesting studies on intestinal compensation following the resection of different portions of the alimentary tract. While success attended his efforts to remove segments of the stomach, jejunum, ileum and colon all his attempts to resect the entire duodenum and transplant the bile and pancreatic ducts into the jejunum were without result. He alludes in detail to the various hypotheses found in the literature which have been advanced to explain the fatal

results attending duodenectomy experiments. Bickel's<sup>2</sup> two duodenectomized dogs which succumbed to days and 4½ weeks respectively after the operation are cited. Stassoff concludes that the reason why animals cannot survive a duodenal resection for any appreciable length of time lies in the fact that the stomach and remaining intestine are unable to compensate fully for this portion of the alimentary tract. Gastric and jejunal digestive activities may for a short time, he thinks, compensate for the loss of the duodenum.

#### METHODS AND RESULTS

The results of the first few experiments sufficed to make it clear that a successful extirpation of the duodenum would depend upon the solution of three main problems: (1) the resection of the duodenum without embarring the blood supply of the pancreas; (2) the transplantation of the major pancreatic duct into the jejunum; (3) and the management of the operation whereby all of the reconstructive steps might be accomplished without sacrificing the life of the animal. It took some time to develop each of the steps in turn.

The first problem which concerns the blood supply of the pancreas was met by excising the duodenum in such a manner that a narrow strip of the muscle fiber through which the branches of the pancreaticoduodenal vessel enter the bowel is left attached to the blood vessel. As the main artery and vein become separated from the intestine where the tail of the pancreas bends away from the bowel the ligation and division of the vessel supplying the distal portion of the duodenum is easily accomplished. Opposite to the body of the gland however it is necessary to make a small incision into the outer layer of muscle cells in the duodenal wall in a direction parallel to the long axis of the latter and close to the peritoneal reflexions over the pancreas. A delicate sheet of muscle cell is then stripped back from the bowel between the two cuts dividing as the dissection continues the branches entering the wall from the adjoining pancreaticoduodenal vessels. These branches are temporarily secured with delicate clamp

Subsequent to the resection the larger bleeders are ligated. Hemostasis is chiefly accomplished however by drawing together the fragments of remaining muscle tissue with a continuous stitch of fine silk. After a little practice this procedure may be accomplished without either opening the lumen of the bowel or leaving behind the smallest trace of mucosa and without in any way interfering with the blood supply of the pancreas.

While the principal object of this research has been to excise the duodenal mucosa in its entirety, it is clear that with the technique just described practically all of the coats are removed since the remaining muscular tissue is so fragmented that at the most only scattered nerve cells may be left behind. The question of the significance of a duodenal nerve plexus so far as it affects the antidiabetic function of the pancreas of course was practically settled by Minkowski.<sup>1</sup> Leaving this aside the function of the duodenum is strictly of a digestive nature. It is concerned with three factors the influences which are exerted upon other parts of the digestive tract by means either of reflexes or of hormones, the digestive juices which enter it from the liver and the pancreas and the secretion which is poured out from the intrinsic glands. All of these factors are inextricably bound up with the mucous coat.

The second problem, namely the transplantation of the major pancreatic duct into the jejunum was successfully solved by using the following technique. After locating the duct which lies between and 3 centimeters proximal to the line of transition between the body and the tail of the pancreas, the adjoining gland for a distance of about 1 centimeter on all sides of the duct is gently stripped back from the duodenal wall. The gland however is not opened to expose any of the intrapancreatic portion of the duct. The muscular coat is now split and the duct freed down to its implantation into the mucosa. At this level it is divided flush with the outer surface of the latter. In this way no fragments of mucous membrane are left attached to it. This affords an extrapancreatic duct which measures approximately 5 to 8 millimeters in length.

At this stage an appropriate loop of upper jejunum is approximated to the pancreas. The jejunum here must lie comfortably without causing any proximal or distal kinking and it must exert no tension on the adjoining gland. A small puncture wound is made in the jejunal wall facing the pancreas through which the duct is introduced into the lumen of the bowel. This step is facilitated by carrying the tip of a delicate needle threaded with silk into the lumen about 1½ centimeters distal to the puncture wound and bringing it out again through the latter. The thread is then attached to the end of the duct. When traction is made upon the thread the duct enters the lumen and the tip is drawn distalward in the intestine. At this time the thread is cut flush with the surface of the bowel. Fine stitches are placed so as to tack the pancreas surrounding the duct to the intestinal wall. The suture line is covered with omentum.

When animals which are otherwise normal are operated upon in this manner they continue in good health. In certain instances however ulcers develop due undoubtedly to the absence of the alkaline pancreatic juice in this segment of the intestine. The occurrence of peptic ulcerations of course has no significance so far as the success of the transplantation itself is concerned.

Subsequent examination shows a natural appearing pancreas free so far as can be ascertained by palpation from any sclerotic process. Histological study corroborates this impression and discloses a normal looking gland. The gross architecture is best understood by referring to the accompanying photograph which pictures a specimen secured by sacrificing an animal 6 months after the duct had been transplanted. The portion of the duct which was left free in the intestinal lumen at the time of the operation has disappeared—presumably a long time back. At the line of transition between the duct and the intestinal mucosa there is a very small circular fold of mucous membrane which serves to protect the former from the contents of the bowel. The duct at its termination here is very narrow and when sought for it is found with difficulty. Distal to the wall of the bowel however there is a dilatation of the duct, most



marked in the portion which traverses the body of the gland.

Istrie Pyle and Vale have recently described a technique for reestablishing a connection between the pancreatic ducts and the intestine somewhat similar to that just outlined. Apparently they were at work on this problem at approximately the time these experiments were underway. While the details of their method differ to a certain extent from the one used here, their results nevertheless serve to emphasize the theme of the preceding paragraph, viz. that the pancreatic duct may be made to function satisfactorily when it is transplanted to anther segment of the intestinal tract.

After the duodenum had been resected the continuity of the gastrointestinal tract of course may be reestablished by means either of a gastroenterostomy or an end-to-end suture at the pylorus. In the experiments referred to here the latter method was used, that is, the end of the proximal jejunum was anastomosed to the open end of the stomach. To insure the complete removal of the duodenum a ring of kaolin with about 1 centimeter wide at the pyloric sphincter was excised as well as 3 or 4 centimeters of the first portion of the jejunum.

Two methods were available for dealing with the biliary supply to the digestive tract, viz. a cholecystenterostomy and a cholecyst gastrostomy. Inference was given to the former procedure though it was shown in some earlier experiment that all of the bile may be diverted permanently into the stomach without in any recognizable way affecting the health and nutrition of the animal.

The third problem concerns the general plan of attack so far as the various operative steps are concerned. Upon this perhaps as much as upon any of the other features depends the success or failure of the undertaking. The experiences of other investigators in this field as well as the results of surgeons who have attempted duodenal resections in human cases indicate most clearly the seriousness of any operation having to do with the proximal duodenum. Aside from any of the plastic or

reconstructive steps the resection simply of this portion of the intestine is conducive to cardiovascular and other changes which suggest or really constitute a state of shock. To undertake then in one operation a transplantation of the pancreatic duct and a suture of the gall bladder subsequent to a duodenectomy is to exceed the limits of physiological reaction.

For this reason the operation was divided into three stages leaving an interval of a number of weeks between each two steps. In the first stage the common duct was identified and divided between ligatures. The gall bladder was then anastomosed to the proximal jejunum. After the animal had fully recovered and apparently were in good health the second step was undertaken. This consisted of a transplantation of the major pancreatic duct—into the proximal jejunum—following the plan outlined in another section of this report. At the same time the lesser pancreatic duct which enters the intestine at the papilla of Vater was dissected out and divided between ligatures. Practically the entire output of pancreatic juice was thus diverted from the duodenum into the upper jejunum.

In the concluding state of the series the duodenum was resected. The surgical difficulties encountered at this time were not inconsiderable since the proximal jejunum was adherent both to the pancreas and to the gall bladder. Where care had been exercised however in the first and second stages in selecting the proper jejunal sites for the resection of the gall bladder and the pancreatic duct it was possible in the concluding operation to anastomose the upper end of the jejunum to the stomach.

This investigation was started in the fall of 1916. As a result of the first or the second operation many of the animal succumbed some to distemper others to pneumonia. Four recovered from the effects of the second stage and appeared to be in excellent condition. Of this number however two subsequently died from an acute peritonitis before it was considered advisable to attempt the duodenal resection. Postmortem examination in each of the six cases disclosed a per

forated peptic ulcer (in the distal duodenum in one animal and in the first inch of the jejunum above the transplanted pancreatic duct in the other) which owed its inception undoubtedly to the absence of the strongly alkaline pancreatic juice from this segment of the intestine. A third dog died at the time of the concluding operation apparently from shock.

The fourth animal which furnishes the basis for this report withstood the third stage well and was active and hungry on the day following the operation. Eight and one half months later it was shown before a medical society and at that time appeared to be in perfect health. Five weeks subsequent to this the dog died rather suddenly having shown symptoms of an acute intestinal complication. At necropsy the jejunum about 3 centimeters distal to the line of the gastrojejunal anastomosis was found to be collapsed and kinked by a peritoneal band which extended across it from the mesentery below to the under surface of the liver on the opposite side. Immediately above this area the intestine was considerably distended. Except for the changes incident to the obstruction nothing abnormal was made out in the abdomen. Both the cholecystenterostomy wound and the transplanted pancreatic duct had healed perfectly. There were no discernible changes in the pancreas. Had there been no accidental complication of this nature it seems fair to assume that the animal would have continued to live in good health.

A careful consideration now of the experimental results of the series as a whole reveals nothing which would indicate that an animal prepared in this way might not live for many years. Certainly there is reason for but little doubt that had there been better facilities at hand for caring for the dogs a much higher percentage might have been carried successfully through the three stages of the operation.

As regards the observations made on this dog the following points may be mentioned. Sugar was never found in any of the specimens of urine obtained either shortly after the resection of the duodenum or in the course of the subsequent months. The appetite was good in fact above the average at all times. While



Fig. 1. Specimen showing an anastomosis between the major pancreatic duct and the jejunum. From a loacroficial six months after the operation. *P* pancreas, *J* jejunum, *D* major pancreatic duct, *O* opening of duct into intestine.

the stools were never examined microscopically they were not unusual in appearance being formed and of the usual color.

The dog was very active perhaps unusually so throughout the 9½ months of observation. This fact probably explains why the animal did not put on more weight. It was a rather small mongrel terrier weighing at the time of the first operation approximately 16¾ pounds. The dog was not quite full grown. Two weeks subsequent to the duodenectomy which was carried out 7 weeks after the preliminary cholecystenterostomy it weighed 16¼ pounds. In the course of the following 9½ months it gained 6 ounces.

In certain preliminary experiments mentioned in another place<sup>1</sup> the major pancreatic duct together with a small segment of duodenum was transplanted into the gastric wall. Two additional stages were used to accomplish an anastomosis between the gall bladder and the stomach and the resection of the duodenum. Each of the animals prepared in this way showed a marked and progressive disturbance of nutrition and succumbed in about 5 weeks (subsequent to the duodenectomy). This picture one of inanition of course affords unmistakable evidence of a great disturbance in the digestive processes at work in the stomach and intestines. A gastritis rather advanced in degree probably also contributed to the animals' condition. Nothing similar to this syndrome was noticed either clinically or at necropsy in the course of the experiments reported at this time.

## SUMMARY AND CONCLUSIONS

From the results of the experiment outlined above certain definite conclusions may be drawn. In the first place they demonstrate that so far as the surgical technique is concerned the major pancreatic duct can be transplanted successfully into the jejunum. Many months subsequent to the operation nothing abnormal is made out in the microscopical or the gross architecture of the pancreas except a dilatation of the duct most apparent in the third proximal to the intestine. The ostium at the lumen of the bowel remains patent.

It is evident in the second place that both the biliary and the pancreatic secretions may be successfully diverted from the duodenum into the upper jejunum. The withdrawal of the alkaline juice from the duodenum must profoundly affect the chemistry of duodenal digestion since peptic ulcer not unfrequently develops here under such condition. The subsequent resection of the duodenum and the suture of the jejunum (which now receive the pancreatic juice) to the stomach eliminates this complication. Upon the reestablishment of channel of communication between the liver and pancreas and the gastrointestinal tract of course depend the character of the nutrition of the animal since serious disturbances in intestinal digestion arise in the absence of the secretions from these glands.

The third point concerns the blood vessel of the pancreas. It is apparent from the protocol of the duodenectomized animal that it is possible to resect the duodenum—every trace of mucosa and approximately all of the muscular coats without embarrassing the vascular supply of the adjacent pancreas. This accomplishment does away with the ne-

cessity of excising the greater portion of the gland and recourse to which Minkowski was forced to turn when he sacrificed the pancreaticoduodenal vessel with the duodenum.

A fourth conclusion may be advanced concerning the plan of the various operative steps. The results of the experimental work outlined above have demonstrated that success can only be looked for in excising the duodenum and carrying out the reconstructive step when the operation is divided into a number of stages leaving an interval of several weeks at least between the successive steps of the procedure.

Finally regarding the importance of the duodenum to the life of an animal the following conclusion may be drawn. Minkowski's experiment sufficed to establish the fact that the resection of the duodenum per se has nothing to do with the development of diabetes. The experiment reported at this time affords indisputable evidence that the presence of the duodenum is not essential to the life and comparative good health of a dog at least for 9 months providing that the pancreas and the liver continue actively to discharge their respective secretion into the gastrointestinal tract. Since the animal reported here succumbed in the end to a complication which has nothing to do with the operative measure suggested for with the loss of the duodenum it seems fair to assume that with a large series of animals working under favorable conditions a few would live for a much longer period of time. From these considerations then it is evident that the conclusion of St. John regarding the inability of the remaining gastrointestinal tract to compensate for the loss of the duodenum are not substantiated by experiment.

## THE MESODERMAL MIXED TUMORS OF THE UTERUS

REPORT OF A CASE OF BOTRIOD CHONDROSARCOMA OF THE ENDOMETRIUM

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MIXED tumors occur more frequently in the urogenital tract than in any other portion of the human body. In the female genital organs they are quite frequently found in the ovary (dermoid teratoma).

They are of rare occurrence in the vagina, the cervix and corpus uteri, and when they occur in these places their heterogeneous components are nearly always of mesodermal origin (smooth muscle and cartilage). In the majority of cases but not always these growths have a grape-like structure and Pfannenstiel (31) called them grape-like sarcoma in a paper of 189 entitled *das traubige Sarcom des Cervix Uteri* assuming that they did not occur in the corpus.

Although this class of neoplasm is very rarely found in the body of the uterus, a number of cases have been reported. In the American medical literature are found reports of two cases of uterine mixed tumors which contained striped muscle reported by Robertson (37) and by Herb (11) but there has been recorded in this country no tumor of the uterus which contains cartilage as a heterogeneous component. On account of their rare occurrence of their pathological interest and their clinical importance I wish to report a new case of this type, a chondrosarcoma of the corpus uteri originating in the endometrium.

*Clinical history.* Mrs. O. Hospital No. 97000 age 54 was admitted to the Michael Reese Hospital on May 8, 1917 as a private patient of J. B. DeLee to whom I am indebted for permission to publish her case. On admission the patient complained of pain in the lower part of the abdomen, backache, headache and vaginal discharge.

*The family history* is negative. There is no tuberculosis, syphilis, lues, diabetes, heart or kidney disease in the family.

*Last history.* The patient was born in Russia. She never had any serious illness except typhoid malaria at the age of 45 but she has never been

very strong. Her family life was not a happy one. She is separated from her husband who maltreated her. She has always been a hard working woman who took care of a large family and lived in poor financial circumstances.

*Obstetrical history.* The patient married at the age of 1. From that time up to the time of the last operation she has had leucorrhoea. Her menstruation has always been regular every four weeks moderate in amount and not painful. She has had twelve full term pregnancies and one miscarriage which terminated her first pregnancy. Ten of her children are living and well.

*Present illness.* Her main complaint is profuse bleeding from the vagina at irregular intervals. Although she is 54 years old she states that she is still menstruating. She takes the irregular profuse bleeding as a sign of change of life. Up to the age of 52 her menstruation as a whole had been regular and normal. The first time she did not menstruate regularly after the birth of her last child was in September 1911. She went then for seven weeks without menstruating and thought she was pregnant. In November 1911 she had difficulty in urination for about one week. She did not urinate for one day at all and when she commenced to urinate she had a bloody discharge from the vagina which continued off and on for 6 to 7 weeks. When she exerted herself the flow increased. On December 15, 1911 she had a hæmorrhage from the vagina and passed a large dark red piece of tissue of the size of a fist which looked like raw liver. This was taken by her doctor and examined. The doctor performed a curettage and advised an operation (patient did not state what kind of an operation) which was refused. Then the menstruation was regular. For the last one and one half years it has been irregular and profuse. She would not menstruate for 3 months or 14 weeks but when she menstruated it lasted for a period of 18 to 21 days and she lost much blood. In December 1916 she flowed for about 4 days and then had a hæmorrhage. H. Ehrenfest, St. Louis, performed a curettage on January 11, 1917. She was in the hospital for weeks and did not menstruate for 7 weeks after that. Since then she has had irregular bleeding. She has lost a large amount of blood. The slightest excitement would cause heavy bleeding. After the operation on January 11, 1917, she had several X-ray treatments. The patient has had backache and pain in the lower abdomen for the last one and one half years since the bleeding started. It is of a burning character and she has a dragging down feeling. Her headache has been present most of

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The e r i n t h e c o n t r a n e r a l s u n e r o s a l l  
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Fig. 1. Photograph of the specimen after it had been hardened in formalin. It is bisected by a median longitudinal section through the anterior wall and shows the polypoid tumor mass on the posterior wall of the uterus. In the upper portion and on the left side of the posterior wall a number of berries are seen. On the right side and in the center are several large, irregular, polypoid masses. In the lower center is a pendulous berry divided by a longitudinal section and attached by a long, thin pedicle. The myometrium is thickened especially in the right upper portion.

before the hysterectomy was performed. De Lee removed them manually and stated during the operation that they felt like "boiled eggs".

**Microscopic description.** The most conspicuous feature in the microscopical appearance is the large amount of cartilage, which in a large number of the sections is the predominating tissue, and which is found in practically every section taken from the larger polypi and berries, but which is also present in the many smaller ones and even in some of the very small villous projections. The internal surface of the tumor is covered by endometrial epithelium, which is present only in the smaller polypi and berries (Fig. 2).

The islands of cartilage are oval, round or crescent shaped. They are surrounded by a layer of spindle cells with deeply blue stained, closely placed nuclei, the perichondrium, which is rather thick in most islands. Around some of the smaller ones these cells are heaped up and go over gradually into cartilage cells. The perichondrium of the larger islands is often thinner, less deeply stained and less conspicuous.

The cartilage is made up of rather closely placed, deeply stained round nuclei which are deposited in a homogeneous ground substance. In the older and large cartilage islands the intercellular sub-



Fig. 2. A longitudinal section from one of the very small villous projections and a portion of a second one. It is covered by the endometrial epithelium. The light-colored areas are composed of loose connective tissue which is myxomatous in appearance, described by Wilms as undifferentiated embryonic tissue. The dark-colored areas scattered about in the tissue are foci of malignant cells from which the cartilage originates. In the malignant foci of round cells near the upper left corner, the beginning of cartilage formation is observed. The slight amount of opaque intercellular ground substance deposited in it produces a lighter color of the central portion. The perichondrium has also commenced to form.

stance is stained light purplish in the younger and smaller islands; it is stained light eosin. Cell boundaries of the cartilage cells cannot be made out as a rule, and no capsules can be recognized, but by close observation with the higher power lens in some of the purplish stained areas cell boundaries can be seen, the cells being round or oval in shape and the nuclei in places are surrounded by faintly stained or unstained areas, suggesting the formation of capsules. However, no definite capsules are present and the cells contain not more than one nucleus each. The eosin-stained ground substance, the absence of capsules and the cellular perichondrium are evidence that this is cartilage in an early stage of development. We see this kind of cartilage in the bronchi of lung sections from autopsies of premature or newborn babies. In some sections especially in those from the larger, brittle polypi and berries, by far the largest portion of the tissue is cartilage. The cartilages are made up of cartilage islands which have grown together as can be seen by the perichondrium which separates them (Fig. 3). Frequently these cartilage islands are separated by a tissue composed of deep blue stained, closely placed spindle cells which look like endometrial





Fig. 4. Another area from the same section. It shows a large number of small, dark-staining cells, which are characteristic of young cartilage with an opaque light brown ground substance. High power magnification.



Fig. 5. A section showing the borderline of the tumor and myometrium. The line of demarcation is distinct. In one place there is a sarcomatous area in the myometrium but this is probably not deeper in the uterine muscle than one frequently finds endometrial tissue.

and a loose connective tissue. In the latter the nuclei are far apart and the tissue is myxomatous in appearance. There are also sarcomatous areas and isolated glands of the endometrial type; the latter however do not participate in the active proliferation but are rather atrophic. In places especially in the smaller polyps the endometrial covering epithelium is left. No smooth muscle and no striped muscle are present. The lymph spaces are dilated.

Nearly all writers who have published reports of these tumors have observed the loose connective tissue described in our tumor. There has been quite a difference of opinion as to the character of this tissue. Wilms (49), Seydel (40) and others try to prove that this is a kind of embryonal mesenchymal tissue from which all the other tissues in the tumor are derived. Some say it is myxomatous tissue as Rein (35), Muciler (4) and Pernice (30) while others take it to be oedematous tissue. Several investigators did the acetic acid test on the fresh specimen and found that this reagent produced cloudiness of the tissue. Others as I fannestiel (31) did the test for mucin

and found it negative. Therefore I fannestiel considers this as proof that the tissue is oedematous and not myxomatous. Still others did not do the test for mucin as Peham (8) but consider this tissue nevertheless to be myxomatous. There are also authorities as Orth and Ziegler who say as stated by Pick (32) that we cannot draw a sharp line between myxomatous and oedematous tissue by the mucin test. Pick thinks it is often not possible to decide if the tissue is oedematous or myxomatous and Keitler (14) states it is proven that myxomatous tissue may develop from oedematous tissue. In our case the tissue has a myxomatous appearance but I am not able to decide if it is myxomatous or oedematous. The mucin test was not done.

The foci of closely placed small round cells which are found scattered about in the loose connective tissue in our specimen have been observed by numerous writers as Seydel (40), I fannestiel (31), Wilms (49), Spuler (41) and Thiede (42). Seydel thinks these round cells originate from the embryonal connective tissue. He saw the transition of the triangular spindle and star shaped connective



tive tissue cell into foci of small round cells. He also saw all stages of transition of the round cells into cartilage as was also observed in our case. This transformation is also proven in Kehrers (13) case. Wilms (49) considers the loose connective tissue as the fundamental constituent of the tumor. It is according to his opinion the undifferentiated embryonal germ tissue from which the other tissue in the tumor are derived.

*Classification and nomenclature.* In the following case report I have collected those cases of uterus and cervix tumor which contain cartilage and striped muscle. Many of them have been classified as grape-like sarcoma in appellation which is a large number is not descriptive. Most of the mixed tumors of the uterus and a great number of those of the cervix are not grape-like in structure. Hennenbach who was the first to collect under the term *chondrosarcoma* included under the grape-like tumor of the uterus him also included one case that Winkler (50) which neither had a grape-like structure nor did it contain heterogeneous tissue. Many of the grape-like sarcoma do not contain heterogeneous tissue but only sarcomatous and chondromatous mixed tissue and many of the mixed tumors are not grape-like in shape.

Beside their grape-like structure and heterogeneous component their great malignancy is one of their characteristic feature. In the large majority of cases this is correct but cases have been reported with evidence of malignancy is that of Schrockner (51) in which the tissue was poor in cell. The most important and characteristic feature of the growth is not their morphological structure but their histologic composition.

We cannot as Veit (43) state "as in the sarcoma colli uteri hydropticum" the grape-like sarcoma of the cervix any proof for a certain anatomical structure. We find this form in histologically simple sarcoma and also in mixed tumor. The grape-like structure therefore should be a secondary consideration in the classification of these tumors; their most characteristic feature is their heterogeneous composition. For this reason I publish this case as a botrioid chondrosarcoma to convey

at the same time the information of its composition and structure.

In our case reports is included the title of the article under which these cases were reported for in most of them the predominant component parts of the growth are indicated.

Several original reports were not accessible and I had to consult the reports of subsequent writer. Of the cases of Levitzky (20) and Cabelman (4) I found neither the original nor reference. I did not include Orth (7) and Schroeder (39) in the table because Schroeder merely states in his textbook that he has seen two cases of grape-like sarcoma one of which had been reported by Kurnert (17) and that he is in possession of a specimen of a polytypous uterine tumor which is composed of pure cartilage.

*Frequency of occurrence.* The table contains eighteen tumors of heterogeneous composition of the corpus uteri and nineteen of the cervix. Of the former there are nine cases which contain cartilage and eleven which contain striped muscle. There are (Lehmann 6 and Hunziker 1) contain both cartilage and striped muscle. Tenkert (9) case contain cartilage and he states that there are all cells which look like striped muscle but no transition seen. It is doubtful if a case reported by Vogler (44) is to be placed in this group. In this case one of the smooth muscle cells looked like striped muscle.

Of the nineteen cervix tumors fourteen contain cartilage and ten striped muscle. Four of them (Koch 49, Bernice 30, Lehmann 8 and Mueller 4) contain both cartilage and striped muscle. Some include Kleinchmidt case in the mixed tumors. He reported a cervix tumor in which in one place was present a tissue which resembled hyaline cartilage.

A tumor reported by Wagner (46) in 1834 according to Williams probably a chondrosarcoma. It occurred in a woman 53 years old. The uterus resembled a thin walled cyst. From its inner portion nodular ridges and many villous structure rose. On microscopic examination cartilage was found. In each lung were about 15 nodules from the size of a pea to the size of a walnut of the same composition as the original tumor.

This case probably belongs to the tumors of the body of the uterus

In Reins (35) Muellers (24) and Pernice s (30) cases cartilage was found only in the primary tumor not in the metastases Gurode (8) and Nehrkorn (26) found striped muscle in the myometrium without tumor formation Gebhard (6) reports a chondro carcinoma of the cervix and others among these Kworostansky (18) report cartilage formation in fibromyoma The mixed tumors of the uterus and cervix differ from those of the vagina for in the latter only striped muscle but never cartilage has been found

*Reason for grapelike growths* The cause of the grapelike structure according to some writers (Kolisko 16) is oedematous infiltration of polyps the oedema being produced by the traction of the polyps by torsion of their pedicles and by pressure from the surrounding structures Some have expressed the opinion that the grapelike structure of the vaginal tumors is produced by their growth from the papillary structure of the vaginal mucosa For the development of the grapelike structure a preformed cavity is necessary It therefore stands to reason that they should occur more frequently in the dilatable and elastic vagina and in the tumors of the cervix which grow down into the vagina than in the uterine cavity with its firm resistant walls However they occur also in the uterine cavity Keitler (14) has reported a case of definite grapelike structure and the writer s case is partially grapelike Some state that the strong and resistant uterine muscle would have to be weakened (pyometra) to make a grapelike growth possible but this statement is not borne out by the writer s case When these tumors infiltrate the adjoining deeper tissues the grapelike structure of the infiltrating portion is lost

*Age* As regards the age at which these neoplasms occur we see from our table that of the sixteen cervix tumors those of Richter (36) and Pick (32) were in patients of about two years each all others were in patients of 17 years or more The oldest patient was 59 years of age and only 3 were older than 50 years Of the corpus tumors 13 out of the 15 patients were 50 years or

over the oldest was 75 years the remaining two were 36 and 38 years old respectively From this we learn that while the mixed tumors of the vagina occur chiefly in children those of the cervix occur mainly at the prime of life and those of the uterus at the time of the menopause In the writer s case the growth occurred at the time of the menopause When questioned the patient stated that she was still menstruating but that for one and one half years the menstruation had been irregular and profuse and that she had had hemorrhages The exact time of the onset of the symptoms cannot be determined for in the beginning the irregular menstruation may have been due to the beginning of the menopause These tumors occur as well in women who have borne children as in those who have never been pregnant

*Duration* In a large number of cases the duration of the disease is not reported In a good many cases it is difficult to state exactly when the first symptoms arose Of the longest duration is Puech and Massabau s (33) case The tumor recurred five years after the operation The patient refused operation for the recurred tumor Among nine cases of cervix tumor which ended fatally the duration was two years or more in three cases over one year in five cases and less than one year in one case Of the tumors of the body of the uterus the duration is known in seven cases The duration of one case was three years of two other cases over two years and in the remaining four cases less than one year

*Termination* The termination of many of these cases is not reported in some it is stated that the tumor recurred The cause of death in a large number was cachexia and exhaustion due to recurrence of the tumor some patients died of exhaustion after the operation some of peritonitis following perforation of the uterus and some of other causes

*Metastases local spreading and recurrence* The malignancy of these tumors manifests itself less by metastases than by local extension and by recurrence after operative removal which often occurs very rapidly At first they spread on the surface the deeper tissues

are infiltrated rather late. The vaginal tumors seem to have more inclination to infiltrative growth into the deeper tissues than those of the cervix and uterus. The cervix tumors infiltrate the pelvic tissue later and those of the uterus very late. Distinct metastases are infrequent and late and as a rule do not contain heterogeneous tissue. Of special interest is Heddlus (10) case since a metastatic growth was found in the pleural cavity which not only had an exclusively grapelike character but also contained the heterogeneous component of the original cervix tumor. Heddlus thinks a metastasis is of undifferentiated embryonic tissue occurred.

**Symptoms.** Clinically it is difficult to differentiate the growth from either malignant tumor of the uterus. The most common symptom is irregular and profuse bleeding as in our case. Frequently there is a vaginal discharge which at first is watery or blood-tinged and which later when decomposition of the tumor set in becomes purulent and very offensive. There may be pain in the pelvis. Large tumor may produce urinary symptoms by pressing on the bladder and urethra. In many cases pieces of tumor are passed by the vagina, in these especially in the case of the cervix and the vagina the tumor may appear at the introitus vulvae. All the symptoms of malignant growth with cachexia, anemia, emaciation, etc. will occur in the later stage.

**Diagnosis.** In two cases the tumor was taken for in hospital male who had suggested by the vascular structure. A certain diagnosis can only be made microscopically. We have to remember that in quite a few cases polyps were removed which were not examined and later the polyps returned and proved to be malignant. Or in Milapert and Maurichau Beauchant's (11) case the polyp was examined and found benign. Therefore a careful microscopical examination of uterine polyps always should be done. This is especially necessary when they recur and in these cases section should be made from different portions of the polyps since cases have been reported where in the primary polyps no malignant tissue was discovered

which possibly may be due to the fact that none was present or perhaps to the fact that one section did not show malignancy while other portions may have contained areas of sarcomatous tissue.

**Prognosis.** The prognosis is generally considered unfavorable. Of nine of the corpus tumor we know the fatal termination. In five of these it occurred six months or less after the operation. Of the other four cases the fatal termination is reported but it is not stated how soon after the operation it occurred. The writer's case is still well eight months after the operation. The case of Murray and Littler (5) was well five months after the operation. We know that of the cervix tumors 1 ended fatally 5 of the 6 within a year after the operation the time is not given in the other 7 cases. In considering the results we have to keep in mind that in many of the cases no radical operation were performed or that they were performed at a late stage after the patient was beyond surgical help.

In spite of these rather discouraging results I am inclined to believe that the outlook in our case is hopeful for the following reasons:

1. The patient has gained in weight and in hemoglobin she has generally improved feeling well and no metastases have been observed eight months after the operation.

The microscopical examination showed the tumor to be confined to the endometrium. There was hardly any infiltration of the myometrium which was thickened and surrounded the tumor like a protective capsule.

3. A radical operation (vaginal panhysterectomy) was performed.

4. Tumors of the uterus are less inclined to metastasize and local infiltration than those of the cervix since the uterus is more an isolated organ and not in so intimate contact with the surrounding tissue as the cervix.

**Histogenesis.** The question which arises when we see such a tumor is: How does such foreign tissue as cartilage and striped muscle get into the uterus? The histogenesis of mixed tumors like that of tumors in general is still unexplained. There are several theories

which try to explain the origin of these tumors Pfannenstiel (31) and v Franque (45) state that the cartilage and striped muscle originate in the uterus by metaplasia. Pfannenstiel thinks the heterogeneous tissue is derived from the connective tissue of the mucosa while v Franque (45) in his report tries to explain the derivation of sarcoma from the connective tissue and of the voluntary muscle from smooth muscle cells. Cartilage is derived from connective tissue in the normal development in prenatal life and also in postnatal life but voluntary and smooth muscle are of entirely different origin and it is hard for us to imagine how the one can be transformed into the other.

According to Cohnheim these tumors are derived from misplaced embryonal cells which suddenly commence to grow for some unexplained reason after having been dormant for many years.

Wilms (49) theory is a sort of combination of the two previous ones. He states that not single cells but undifferentiated embryonal germ tissues are split off and misplaced. He assumes a common mother tissue from which cartilage as well as striped muscle may commence to grow while Cohnheim's theory presupposes the displacement of the single components.

*Process of germ displacement.* The frequency of the occurrence of these mixed tumors in the urogenital region is explained by the complicated growth in the embryonal development. According to Wilms the mother tissue comes from the region behind the kidney anlage. In the early embryonal development we find here the prevertebrae or myotomes from which cartilage as well as striped muscle may originate. Their middle portion produces the voluntary muscle and their ventral portion the sclerotome is the beginning in the formation of the vertebrae. In this region appears at an early stage in the embryonal development the nephrotome and the wolffian duct. The latter grows progressively backward toward the cloaca. In its backward growth it takes some of the embryonal germ tissue with it. Its terminal portion atrophies and persists along the vagina and uterus as Mueller's duct. These embry-

nal germs remain dormant until they wake up suddenly at some later period commence to grow and produce a malignant growth.

This theory explains the site of the tumor its heterogeneous composition and also the embryonal character of the tissue which is found in many of them but it does not explain why these cells remain dormant for forty or fifty years and then suddenly commence to grow. It also does not explain how germs for mixed tumors get into the parotid gland or other places. Wilms' theory is probably today recognized more generally than any other but we should not forget that it is merely a theory not based on scientific proof and that at present it is entirely impossible to give a satisfactory scientifically proven explanation for the origin of these tumors.

#### SUMMARY

The mesodermal mixed tumors of the corpus and cervix uteri contain striped muscle and cartilage or both as heterogeneous products. In many of them a loose connective tissue which is myxomatous in appearance and contains foci of small round cells is observed. The mixed tumors of the vagina contain smooth muscle only and no cartilage and occur chiefly in children; those of the cervix occur chiefly at the prime of life; those of the corpus uteri occur at the time of the menopause or later. Nineteen mesodermal mixed tumors of the cervix and seventeen of the corpus were found reported in the literature. To the latter the author adds a report of a botrioid chondrosarcoma of the endometrium. The grapelike structure of some of these growths is no proof for a certain histological composition.

Clinically these neoplasms are characterized by their tendency to local recurrence after removal and to local extension. Distant metastases are infrequent. Their symptoms do not differ from those of other malignant growths in this region.

The diagnosis can only be made by histological examination. The prognosis is generally considered unfavorable and the treatment consists in early and radical operative procedure.



The patient age 5. VI para had a polypoid pediculated tumor in the vagina extending from the cervical canal. This recurred although they had been removed twice. Histological findings: Cartilage and mixed cell sarcoma treated by lymph.

CASE 6 Reported by Puech and Mastrouau (33) in 1908 in an article entitled *Les tumeurs de la cavité utérine*. The patient age 59 had a pediculated grape like tumor in the vagina extending from the cervix. The patient was well for five years when the growth recurred and she refused operation. The condition lasted for more than 15 years. The lengthening of the symptoms until publication of paper. Histological findings: Embryonic myxomatous tissue hyaline cartilage and fibrous tissue fusiform cells (sarcoma) glandular tissue.

CASE 7 Reported by Heddäus (10) in 1911 in an article entitled *Uterus mit Myxosarkom*. The patient age 48 the mother of several children had a uterine polyp which recurred. Hysterectomy as done. Her trouble lasted for 30 years. She had a grape like tumor in the pleural cavity. The patient died four weeks after operation. There was hemorrhage and edema in the thorax and dyspnea. Histological findings: Chondrosarcoma of the mucosa. Irregular celled sarcoma hyaline cartilage and glandular tissue myxomatous tissue and perhaps fat. The pleural tumor has the same composition as the cervical tumor.

CASE 8 Reported by Leitzky (20) in 1900 in an article entitled *Chloroma der Uterus*. The patient age 40 had a polypoid tumor in the vagina extending from the cervix. The patient died four weeks after operation. There was hemorrhage and edema in the thorax and dyspnea. Histological findings: Chondrosarcoma of the mucosa. Irregular celled sarcoma hyaline cartilage and glandular tissue myxomatous tissue and perhaps fat. The pleural tumor has the same composition as the cervical tumor.

CASE 9 Reported by Michel and Hoche (3) in 1900 in an article entitled *Uterus mit Myxosarkom*. The patient age 40 had a polypoid tumor in the vagina extending from the cervix. The patient died four weeks after operation. There was hemorrhage and edema in the thorax and dyspnea. Histological findings: Chondrosarcoma of the mucosa. Irregular celled sarcoma hyaline cartilage and glandular tissue myxomatous tissue and perhaps fat. The pleural tumor has the same composition as the cervical tumor.

# CASES OF MESODERMAL MIXED TUMORS OF THE CORPUS UTERI

CASE 1 Reported by Anderson and Erdman (1) in 1899 in an article entitled *Uterus mit Myxosarkom*. The patient age 50 had a polypoid tumor in the vagina extending from the cervix. The patient died four weeks after operation. There was hemorrhage and edema in the thorax and dyspnea. Histological findings: Chondrosarcoma of the mucosa. Irregular celled sarcoma hyaline cartilage and glandular tissue myxomatous tissue and perhaps fat. The pleural tumor has the same composition as the cervical tumor.

CASE 2 Reported by Bystroumoff and Eckert (2) in 1874. The patient had a polypoid pediculated tumor extending from the fundus. Histological findings: Completely developed striped muscle cells. There are also spindle cells with two and three nuclei.

CASE 3 Reported by Colomatti (1) in 1888. The patient had a tumor of the size of a child's head which probably originated in the corpus uteri. There are three recurrences. There are probably metastases in the lungs. Death from pleurisy. Histological findings: Large round cell striated muscle.

CASE 4 Reported by Caisser (7) in 1891 in an article entitled *Uterus mit Myxosarkom*. The patient age 55 had two abortions. She had a tumor arising from the posterior and lateral walls of the uterus. Histological findings: Spindle and round cell sarcoma arising from endometrium-cartilage.

CASE 5 Reported by Franqué (45) in 1899 in an article entitled *Myosarcoma striatum re corporis uteri hydropticum*. The patient age 49 VI para had a growth the size of a man's head hanging from the fundus. There were lobulated polypoid masses in the uterine cavity growing on top of a myoma. Hysterectomy as done. The patient died from exhaustion one week after operation. Histological findings: Striated muscle spindle cell sarcoma.

CASE 6 Reported by Reid (34) in 1902 in an article entitled *Clinical Notes on Myxochondrosarcoma of the Uterus*. The patient age 59 VI para had a lobulated tumor which filled the uterine cavity. The uterus was the size of a four months pregnancy. Vaginal hysterectomy was performed. Histological findings: Myxomatous tissue hyaline cartilage.

CASE 7 Reported by Gebhard (5) in 1903 in an article entitled *Uterus mit Myxosarkom*. The patient age 36 had had eleven or twelve pregnancies. She suffered from a pedunculated tumor hanging from a dilated cervix. The tumor probably originated from the fundus uteri. Hysterectomy was done. Histological findings: Cartilage spindle cell sarcoma. Striated muscle proliferation of endothelial cells resembling carcinoma.

CASE 8 Reported by Penkert (29) in 1905 in an article entitled *Uterus mit Myxosarkom*. The patient age 36 had had eleven or twelve pregnancies. She suffered from a pedunculated tumor hanging from a dilated cervix. The tumor probably originated from the fundus uteri. Hysterectomy was done. Histological findings: Cartilage spindle cell sarcoma. Striated muscle proliferation of endothelial cells resembling carcinoma.

CASE 9 Reported by Lae (19) in 1905 in an article entitled *Uterus mit Myxosarkom*. The patient age 60 had a polypoid growth originating from the posterior uterine wall. Hysterectomy as done. The condition had been present for three years. Metastases were found in the peritoneal cavity. General peritonitis followed perforation of the uterus and the patient died. Histological findings: Spindle cell sarcoma smooth and striated muscle large multinuclear cells.

CASE 10 Reported by Malapert and Mauchau Beauchet (2) in 1905 in an article entitled *Uterus mit Myxosarkom*. The patient age 64 had no pregnancies. She had tumor masses which extended throughout the uterus and vagina. The tumors recurred after repeated operations for removal. The patient suffered a year and one month and died from cachexia. Histological findings: Striated muscle removed and a diagnosis as fibro myoma. In the second one was cartilage sarcomatous and myxomatous (?) tissue.

CASE 11 Reported by Hunziker (1) in 1907 in an article entitled *Uterus mit Myxosarkom*. The patient age 58 II para had pediculated nodular tumors filling the uterine cavity. The tumors originated in the anterior wall of the uterus. Hysterectomy as done. The trouble recurred and the pelvis became invaded. The trouble lasted for five months. Metastases occurred involving the rectum and bladder. The patient died from cachexia four months after operation. Histological findings: Cartilage striated muscle smooth muscle myxomatous tissue.

CASE 12 Reported by Robe (3) in 1909 in an article entitled *Uterus mit Myxosarkom*. The patient age 69 II para had a pinkish soft lobulated tumor probably primary in the corpus. She had not been

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## ADDENDUM

Following is an extract of a letter dated January 11 1918 for which I am indebted to Dr Hugo Lhrenfest St Louis It was received after this article had been sent to the editor and gives additional information regarding the clinical history

My records on the case of Mrs S OX are not very complete however I shall give you everything I have

The patient was seen by me for the first time on January 11 1901, sent by a physician who had made the diagnosis of inoperable carcinoma At the time she was 54 years old married 13 years had given birth to twelve children at full term the last eleven years ago Menstruation was perfectly regular until approximately 10 years ago from then on it would appear some had delayed until finally it would come in intervals of from three to four months The previous seven to eight days flow abundantly had lengthened out from fourteen to sixteen days however never being very free About three months ago she had a rather normal menstruation of eight days duration after that would be perfectly free of any vaginal discharge until five weeks ago when another flow started at that time (never before) free labor like fun This flow started unusually free gradually lessened and has persisted ever since At present she complains only of very slight pain in the region of the symphysis and back The patient is well nourished and the visible mucous membranes are approximately normal in color

On examination I found the vagina filled with a soft bulbous mass as big as a fist High up the intact edge of a limited smooth surfaced cervix as palpable within the cervix a thick pedicel perfectly free all around had run up into the greatly enlarged irregular surfaced uterus which apparently contained several subserous fibroids The diagnosis of pedunculated necrotic bleeding submucous fibroid as made and the patient admitted to the hospital On January 15 under ether anesthesia this mass was removed with the curette It was soft mushy ill smelling attached to the site of a fist and seen reaching to the posterior uterine wall just above the internal os No sutures or ligatures were required The uterine cavity was packed tightly with iodoform gauze The laboratory report unfortunately stated briefly that the tissue examined was in such a decayed condition that it was impossible to determine whether it was malignant but nothing was suggested of malignancy was discredited The patient made an uninterrupted recovery without rise in temperature and was given two months of rest before leaving the hospital on January 28

She remained free of any bloody discharge up to the first few days in March I saw her only once more on April 3 just before she left for Chicago and made the notation that there was slight bloody discharge continuing for the last several weeks I found the uterus greatly enlarged still superiorly the sacral cavity When the cervix a large blood clot as seen protruding from the uterine cavity

This is all the information I am able to give you The surprising outcome of so far further histological study of the case of course is exceedingly interesting

and made me feel that I probably could have cognized the true state of affairs by a more careful study of the tissue removed at the first operation. However clinically the case surely did not suggest any malignancy and in every detail offered the typical picture of a half expelled submucous fibroid.

I am sorry to state that my favorable prognosis with regard to the recurrence of the tumor was correct. The patient had been well after the operation up to April 5, 1918, when a slight pinkish discharge from the vagina occurred. She consulted physician immediately and Emil Ries performed curettage on April 9. Only a small piece of granulation tissue of about the size of a small nut was found in the vault of the vagina and removed. Microscopical examination did not reveal malignancy. The discharge discontinued after the curettage but recurred on June 1 and on June 4 a parotomy was performed by Ries to whom I wish to express my thanks for the information and for the specimens which were removed.

The right ovary and tube formed a tumor of about the size of an egg adherent to the vault of the vagina. The left ovary and tube formed a tumor of about one half that size. Both tumors were removed. I saw the specimens after they had been hardened in alcohol. In places probably at the site of the attachment to the vault of the vagina there was loose tissue of irregular structure having polyp-like projections measuring up to centimeters in length which were similar in appearance to the original tumor.

Microscopical examination showed this to be mesodermosarcomatous tissue of the same character as described in the original tumor. Sections were taken of different portions of ovary and tubes and these structures themselves were not found invaded by the malignant growth.

Several writers called attention to the extraordinary malignancy of this class of tumors. In spite of this I was inclined to believe that the tumor would not recur since as stated previously it was limited to the corpus uteri since a complete hysterectomy was performed and the patient as well and gained weight after the operation. That a recurrence followed this radical operation is a further evidence of the unfavorable prognosis which should be made in this kind of neoplasm.

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## SHALL OPERATION FOR HYPERTROPHIED PROSTATE BE DONE IN TWO STAGES

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AL surgical procedures are gradually developed. The operation for the relief of hypertrophied prostate is no exception to this rule. We first learned that the condition was amenable to operation. Suprapubic and perineal operation were developed. We had to decide which of the two operations gave the best result. This question I think has been decided. I think I am safe in stating that every one has abandoned the perineal operation except one genito-urinary surgeon and the minority of general surgeons. We are at present deciding the question whether the operation shall be done in one or two stages.

When a patient comes to us asking for relief from an hypertrophied prostate two questions must be decided: (1) Can this patient be safely operated upon? (2) If so, when? The first question is answered by a general physical examination of the patient. The second by a study of the urine and its secretion. In order that we may judge the condition of the urine with reasonable accuracy, a comprehensive knowledge of the pathology of the hypertrophied prostate and its effect on the anatomy and physiology of the kidneys is necessary. In few conditions can cause and effect be more clearly followed.

Briefly stated, the pathology is the development of a fibro adenoma in that part of the prostate lying between the verumontanum and the internal sphincter of the bladder. As this tumor develops it causes a mechanical obstruction at the outlet of the bladder and at the same time causes such an alteration in the shape of the bladder that it can no longer spontaneously empty itself and residual urine results.

Whenever the bladder contains 100 cubic centimeters of residual urine, the urine backs up into the pelvis of the kidney. The pressure of the urine on the surface of the kidney

causes a flattening of the pyramid and a broadening of the calyces. This must cause a more or less marked distortion of the urinary tubules. The kidney reacts to this pressure by passing large quantities of low specific gravity urine. Just how long this pressure and distortion must exist before the function of the kidney is modified we do not know, but we do know that where a large quantity of low specific gravity urine is found a change in the structure of the kidney has occurred. We know that the kidney of some individuals will continue to secrete apparently normal urine although a large amount of residual may be present. It however we drain the bladder of one of these patients we find just as in the case of a patient who is passing low specific gravity urine a fall in blood pressure and if the drainage is made continuous a large percentage of them will develop uræmia. We are therefore justified in assuming that although they are passing apparently normal urine a change has occurred in the kidney tubules of the men.

The pressure of the urine in the pelvis of the kidney is mild but continuous because these patients never empty their bladder completely. The alteration in the shape or the distortion of the tubules occur so slowly that they retain their function somewhat modified as they gradually assume their new position. The reverse is true when we suddenly relieve the pressure in the pelvis of the kidney by completely emptying the bladder. The compressed kidney fails to return to its normal shape very rapidly and the tubules which have become accustomed to an abnormal position are not able to perform their function in the normal position. If the drainage of this bladder is made continuous the amount of urine passed is rapidly diminished and the patient becomes uræmic in three or eight days. If now we discontinue drainage and allow the pelvis of the kidney to refill with urine again

applying pressure to the surface of the kidney that is return the tubules to the abnormal position which they have occupied they again take up their function and the uremia immediately begins to disappear

My objection to doing suprapubic cystotomy as a preliminary to a prostatectomy is that if the patient becomes uremic after having established continuous drainage by cystotomy we cannot refill the pelvis of the kidney and replace the kidney tubules to abnormal position under which they formerly functionated. On the other hand if we do the preliminary drainage with a catheter and our patient begins to show signs of uremia we can withdraw the catheter and in a few hours the pelvis of the kidney will refill and the kidney tubules being replaced to their abnormal position will again functionate. The operation of prostatectomy is in itself not a serious undertaking. It is the sudden emptying of the pelvis of the kidney that makes it dangerous. Where death occurs following a prostatectomy the death certificate reads "Renal insufficiency." If death follows a suprapubic drainage the certificate is made to read "Uremia." The cause is the same the sudden emptying of the renal pelvis.

In an article entitled "Blood Pressure and Prostatectomy" published in *Annals of Surgery* December 1916 A. H. Peacock of Seattle gives in analysis of a series of seven prostatectomies. Six of these were preceded by preliminary cystotomy therefore we will only consider these six.

**CASE 1** Patient aged 64. The condition of urine is not mentioned. The man made an uneventful recovery.

**CASE 2** Patient aged 64 passing urine of 1000 specific gravity. Cystotomy was done with a local anesthetic. The man died on the fourth day of uremia. Prostatectomy was never done.

**CASES 3 to 6** Age of patients varied from 58 years to 84 year all passing urine of specific gravity varying from 1000 to 1024. A preliminary cystotomy was done in the four cases. Prostatectomy was done on the third day following cystotomy in three cases and on the fourth day in one. Of these four cases all passing apparently normal urine one made an uneventful recovery one died seven days after preliminary cystotomy and four days after prostatectomy from uremia the other two became uremic but recovered. The amount of residual urine is not given in all of the case but the report shows

that the patient who died from cystotomy had an overflow bladder while the two who became uremic but recovered had a residual of 45 cubic centimeters and 100 cubic centimeters respectively. (Peacock notes in his report that in the three which developed uremia there was great diminution in the amount of the urine secreted.)

So from the six cases treated by preliminary cystotomy two died two became uremic and recovered two made uneventful recoveries. Peacock says the deaths of the two and uremias in the other two are due to what he has called hidden nephritis. To me it means that when the pelvis of the kidney was completely emptied the compressed kidney tissues returned so rapidly to normal position that the uriferous tubules which had been for a long time in an abnormal position were not able to perform their functions when suddenly returned to normal position.

A patient Mr V. age 63 years came under my care at the Minneapolis City Hospital on June 23, 1916 suffering from hypertrophied prostate and acute retention of urine. He had blood pressure 168 - 170 catheter drainage was introduced and his blood pressure promptly fell to 100. At the end of four days the old man became uremic. The catheter was taken out and from that time he was catheterized twice a day. His blood pressure promptly rose to 148 and his uremia cleared up. At the end of the fifth day in attempting to catheterize him the interne was unable to pass a soft catheter and under took to use a metal catheter and made a false passage. Being unable to get a catheter into his bladder I made a suprapubic cystotomy. The old man's blood pressure promptly dropped to 100. He became uremic and died of uremia on the nineteenth day after cystotomy was performed. His death I believe was due to permanently relieving the kidney of the pressure to which it had for years been accustomed.

## CONCLUSIONS

1. All cases including those cases where only a small amount of residual urine is present should be given several days of preliminary drainage before prostatectomy is done.

2. Since cystotomy which gives permanent drainage to the bladder and the pelvis of the kidneys has been followed by death I believe that it is better that drainage should be made by the use of the catheter.

3. Cystotomy should be reserved for use in those cases where catheterization for any

reason is impossible or for use in those cases of acute cystitis that do not do well with permanent catheter

4 Since uremia has been known to follow the opening of a bladder which contained only

45 cubic centimeters of residual urine if compelled to do a cystotomy it should only be performed after catheterization or aspiration of the bladder has been carried on for several days

## A VARIETY OF MASSIVE SYPHILITIC SPLENOmegaly ATTENDED BY RI MARKABLE VASCULAR CHANGES

By DOUGLAS SYMMERS M.D. NEW YORK

I f f P h i U ty J B H H p M d C o l l D f L a b e s B H d A l l e d H p i

### CHEMICAL REPORT

By ALEXANDER O. CETTLER I.H.D. NEW YORK

I h i f C h m B H H f i i

### TECHNICAL WORK

By WILLIAM M. JOHNSON NEW YORK

THE purpose of this communication is to call attention to a form of siphilitic splenomegaly attended by naked eye changes which are readily identified and by extraordinary microscopic alterations referable particularly to the smaller arteries of the splenic substance. In addition to its size the organ is remarkable in that on section the naked eye detects pin head sized ochre colored bodies which upon microscopic examination are found to correspond to thickening and hyalinization of the walls of the smaller arteries with extensive deposits of mineral salts in the fibromuscular and elastic coats. The vascular apparatus of the spleen is further compromised by mineral free hyaline deposits in or around the small veins and by hemorrhagic extravasations in various stages of organization. Only two cases of a similar description have been found in the literature of medicine. In neither of them was syphilis mentioned as a possible etiological factor.

In the case recorded by Sprunt (1) the liver was the seat of an infective biliary cirrhosis and the abdomen was distended by fluid. The spleen weighed 775 grams. Small ochre colored bodies which were visible to the naked eye were found on microscopic

examination to represent elective impregnation of the elastic tissues in the smaller arteries by salts of calcium and iron.

In the case described by Marini (2) the spleen weighed 1900 grams and similar but less extensive microscopic changes were found in the smaller vessels. Marini regarded his case as an example of the splenomegaly of the so-called Banti's disease. This according to the views of the Italian school is equivalent of course to a denial of syphilis as the causative factor since this school hold that Banti's disease constitutes an entity of unknown etiology. According to the investigations of Norm Symmer and Shapiro (3) however the splenomegaly of Banti is to be explained exclusively as a syphilitic process and Banti's disease as an independent clinical and anatomical entity does not exist. This conception is based on the fact that of those cases of clinically typical Banti's syndrome investigated by them at Bellevue Hospital over a period of twelve years all when pursued to a conclusion were found to occur in subjects in whom syphilis was determined with certainty not only by the histological alterations in the spleen—which incidentally are not to be distinguished from those enumerated by Banti—but by

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the presence of syphilitic changes in other parts of the body. Since these observations were published I have investigated 3 additional cases of clinically typical so called Banti's disease occurring in Bellevue Hospital and all were in syphilitic subjects. Moreover the cases described in the present paper correspond from a clinical viewpoint to one or another stage of so called Banti's disease as originally outlined by the Italian pathologist and in fact three of them were so diagnosed during life and yet there can be no doubt I think that every one in the entire series was syphilitic in origin.

The argument that relief after splenectomy in the so called Banti's disease is confirmation of the independent nature of the condition is indeed spurious. In the first place removal of the enlarged spleen of syphilis not infrequently is followed by relief of certain symptoms notably the anemia. In a case operated on by Dr John A Hartwell the patient who previous to splenectomy was intolerant of antisyphilitic treatment now improved under specific therapy. In Giffin's cases (4) splenectomy was likewise beneficial and similar results have been recorded by others. In the same way splenectomy in pernicious anemia is sometimes followed by noticeable if temporary improvement and in certain forms of hemolytic jaundice with increased fragility of the red cells the operation is curative. The contention that in so called Banti's disease splenectomy prevents cirrhotic changes in the liver that otherwise would occur argues a prescience vouchsafed to none. So also the assertion that splenectomy in so called Banti's disease is followed by cessation of an otherwise progressive cirrhosis of the liver while it may have some basis founded on intelligent reasoning has not been shown to be a fact as revealed by remote investigation of the patients thus treated although like many dialectical trickeries the statement carries with it just enough of the probable to lend it a degree of force.

Six cases of the extraordinary variety of splenomegaly about to be described have been studied in the Pathological Laboratories at Bellevue Hospital. Five of the cases occurred

in males and one in a female. The ages were 2 3 38 50 45 and 9 years. One case occurred in a subject whose liver revealed the naked eye changes of hepatic lobatum. A second case was that of a patient with a strongly positive Wassermann reaction associated with generalized superficial lymphadenopathy and bilateral symmetrical ulcerative lesions in the region of the external malleoli that appeared at intervals for 15 years healing slowly only to break down again finally disappearing completely after splenectomy and under antisyphilitic treatment. A third case occurred in association with hepatic lobatum and a left sided chronic interstitial orchitis with extensive fibrous replacement. A fourth case was encountered in an individual with a syphilitic scar in the liver irregularly distributed patches of testicular fibrosis and syphilitic cirrhosis of the lymph nodes. A fifth case was in an individual with a positive Wassermann reaction and the characteristic microscopic changes of diffuse syphilitic splenitis. The sixth case was in a man with hepatic lobatum and a solitary gumma of the liver.

In one case no blood examination was made the individual having died unattended by a physician. In a second case examination of the blood showed no noteworthy deviations from the normal. A third case was marked by a grave secondary anemia which after splenectomy and under specific treatment improved greatly. In the 3 remaining cases the count of the red cells was practically normal but there was distinct leukopenia.

In 4 cases ascites was present and in all of them the liver was cirrhotic. In one of these cases however the initial distention of the abdomen occurred with extreme rapidity and ascites recurred promptly after paracentesis due as shown by autopsy to thrombosis of the portal splenic and superior mesenteric veins. In the two remaining cases ascites was absent and in both the liver was free from cirrhosis.

The weight of the spleen in the several cases was 3410 175 1050 1040 1150 and 100 grams. In one case microscopic examination showed sclerosis and mineralization of practically every one of the smaller arteries



ed by the interposition among the red cells both at the periphery and elsewhere of minute connective tissue fibrils and fibroblasts. That organization had in certain instances proceeded to completion was shown by the presence of scattered islands of dense fibrous tissue. The multiphagic bodies were few in number and poor in cells. Most of them lay in the immediate vicinity of the mineralized arterioles. (See Fig. 1.)

*Spirochete pallidum* could not be identified. *Chemical Analysis* Inorganic substances only. Normal and diseased spleen. Organic material destroyed and eliminated by ashing, all work being done in platinum with 5 grams samples of dried material. If ashing was done at as low heat as possible all the resulting material in both the normal and diseased spleens was practically soluble in hot dilute hydrochloric acid a little carbon remaining. If however the ashing was performed at a higher temperature the resulting material in the diseased spleen would not dissolve entirely. There was left a white insoluble substance which not only resisted solution in all strengths of hydrochloric acid both cold and after prolonged boiling but also three days leaching in dilute hydrochloric acid. The normal spleen yielded no such substance. Furthermore upon treating this white insoluble residue after thorough washing with sodium hydroxide solution and boiling (in platinum) it dissolved and immediately changed to a brown precipitate. If hydrochloric acid was now added this brown precipitate dissolved readily and in its place a colorless gelatinous precipitate appeared. The solution had a yellow color and gave a strong Russian blue test. From the above properties there can be no doubt that the white insoluble residue was produced during ashing from the iron and silica of the spleen and was an anhydrous iron silicate compound.

*Silica* To determine the amount quantitatively the ash from 5 grams of dried material was dissolved in dilute hydrochloric acid the white residue decomposed by sodium hydroxide solution and added to the main portion. Then it was acidified with hydrochloric acid and evaporated to dryness moistened with concentrated hydrochloric acid again evaporated and heated to 120 degrees C for two hours again moistened with concentrated hydrochloric acid and heated to 120 degrees C for 4 hours. Then dilute hydrochloric acid was added and boiled this dissolved all except the dehydrated silica which was filtered off washed ignited and weighed.

*Phosphate* After removing the silica the phosphate was precipitated by ammonium molybdate dissolved and precipitated as  $(NH_4)_2MgF_6$  ignited and weighed as  $MgF_2$ .

*Iron* To the filtrate from above  $H_2SO_4$  was added and evaporated to a syrup heated with small flame until fumes of  $SO_3$  were liberated diluted with water  $H_2S$  passed through warmed and left standing over night. This removes all the molyb-

denum. The excess of  $H_2S$  was boiled out and the iron precipitated as  $Fe(OH)_3$  then ignited and weighed as  $Fe_2O_3$ .

*Calcium* To some of the original solution of the ash ammonium carbonate was added until slightly cloudy then a few drops of hydrochloric acid to clear then ammonium acetate and ferric chloride until all phosphate were precipitated and the solution became brown. Three hundred cubic centimeters of water were added boiled thus precipitating the excess iron as basic acetate this was filtered off and evaporated to dryness the ammonia salts driven off dissolved in hot water plus 2 drops hydrochloric acid and the calcium precipitated with ammonium oxalate after adding sodium acetate solution. The calcium oxalate was filtered washed ignited and weighed as  $CaO$ .

*Magnesium* The filtrate from the above was evaporated to dryness ignited to drive off all ammonia salts dissolved in dilute hot  $HNO_3$  made ammoniacal and precipitated as magnesium ammonium phosphate and weighed as  $Mg_2P_2O_7$ .

*Sodium and potassium* The original solution of ash was used. Silica removed by dehydration sulphates by  $BaCl_2$  iron by ammonium phosphate by  $Ba(OH)_2$  calcium and magnesium by  $NH_4OH$  and  $(NH_4)_2CO_3$ . Filtrate evaporated to dryness ignited to drive off ammonia salts the residue dissolved in dilute hydrochloric acid filtered into tared dishes evaporated to dryness heated with low flame and weighed as combined  $NaCl$  and  $KCl$ . After weighing it was dissolved the potassium precipitated as  $K_2PtCl_6$  and weighed as such.

From the combined  $KCl$  and  $NaCl$  was subtracted the  $KCl$  calculated from the above  $K_2PtCl_6$  thus obtaining the  $NaCl$ . All results were calculated and are reported as oxide.

# RESULTS

N P	m g	Sp l		E r	g d	Sp l
Dry	100	gr	m	Dry	100	gr
	06				315	
	151				141	
I	140				385	
	305				16	
	136				484	
	27				28	
	08				240	
	802				2000	
N T F	m g	Sp l		E r	g d	Sp l
T F	100	gr	m	T F	100	gr
	034				1953	
	05				84	
	191				38	
	051				330	
	123				3001	
	03				1413	
	005				1486	
	466				145	

Analysis reveals the following points of interest. The potassium in the diseased spleen is diminished by about one third but the sodium very little. The content of phosphate is unchanged. The calcium is increased by about a half and the iron diminished to the same extent. The latter finding is to be explained by the fact that the iron values represent the total quantity of tissue iron plus the iron of the splenic blood. Since the extensive arterial changes in the enlarged spleen indicate diminution in the quantity of circulating blood in the organ the iron content is correspondingly affected. The silica is increased ninefold. It seems not improbable that the golden granules found in such abundance in histological preparations of the diseased spleen represent some variety of silicate either iron silicate or even a silicate of calcium. It is also interesting to note that the total inorganic material weight for weight of tissue is not more in the enlarged spleen but rather a little less. This is due to the great reduction in potassium and iron which overbalances the increased amounts of calcium and silica. Moreover it appears that the increase in inorganic salts is parallel with the size of the respective spleens.

CASE 2. The subject is a man who although unattended by a physician and nothing could be learned from his history. The autopsy was done by O. H. Schultz, the medical assistant to the district attorney in the County of New York. I am indebted to Dr. Schultze for the privilege of using the material for purposes of microscopic investigation.

The body of that of an emaciated man about 35 years of age. The skin and visible mucous membrane were bleached. On opening the peritoneum an enormous quantity of blood came into view lying between the lower border of the stomach and the pancreas.

The spleen, huge, reaching well down into the pelvis, weighed as follows: as for forward as the middle line it weighed 340 grams and measured 28.7 x 2.3 x 8.7 centimeters. The capsule was thickened and strewn with pinhead sized cream colored projections. On section the organ cut the resistance. The splenic substance was somewhat looked dense and was leathery in consistency. Scattered throughout it were dots of

pinhead sized or slightly larger rounded oval or angulated bodies each of which presented a granular looking yellowish or yellowish brown center. Many of these bodies were surrounded by a distinct reddish halo. The malpighian follicles could not be distinguished. Small hemorrhagic splotches were numerous and easily seen. The splenic artery and vein were dissected for several centimeters. The artery was markedly calcified stiffened and tortuous. The veins as distended and thrown into small pouch like dilatations the walls of which were translucent and scarcely more than the thickness of tissue paper.

The lymph nodes were not enlarged. A group of small grayish red granular looking nodes was removed from the region of the base of the pelvis and placed in a microscopical examination.

The liver weighed 50 grams. The surface was marked by the presence of the capsule of the right lobe of the liver which extended downward to the upper part of the organ and distance of 10 centimeters.

The base of the tongue and the testicles were well preserved. The bone marrow of the ribs was hyaline plastic. The succulent looking and bluish red color.

The rest of the organs presented nothing worthy of record in the present connection.

HISTOLOGY. Microscopic examination of the spleen revealed large numbers of thickened hyaline minute bodies of identical histology with those already described. Hyaline thickening of the wall of the venule occurred in only a few instances. The interstitial changes were of the form of groups of fibrils well grouped dilated capillaries many of which had ruptured producing hemorrhagic extravasation. The hemorrhagic areas were infiltrated by fibrin clots and traversed by fibrillar connective tissue fibrils. Running through the splenic tissue in all directions were connective tissue fibrils of fibrillar connective tissue which stood brightly by the Van Gieson method of staining. A urinary degree of placement of the splenic substance (See Fig. 3). Between the connective tissue bands the connective tissue number of highly dilated venous sinuses some of them filled by red cells, other empty. The malpighian follicle were few in number. Some were small, poorly cellular, others were

outlets of connective tissue replacement. Splenic capsule could not be demonstrated in the spleen.

TESTES. Microscopic examination of the testes showed patches in which the interstitial tubules were thickened and hyaline in which the testicular substance had been replaced by dense fibrous tissue.

LIVER. Microscopic examination of the scar in the liver showed a broad band of fibrous tissue which penetrated deep into the substance of the organ occasionally branching in such fashion as to enclose small groups of liver cells. In place of the scar

densely fibrous in other places it enclosed circumscribed collections of round cells

**Bone Marrow** Smears from the marrow of one of the ribs revealed immense numbers of red cells and lymphocytes. That the increased number of lymphocytes was not to be explained on the basis of leukemia was shown by the absence of hyperplasia of the lymph nodes in any part of the body and of hyperplasia of the follicles in the spleen by the absence of lymphocytic infiltration of the viscera and by the absence of increased numbers of lymphocytes in sections of the vessels in the different organs

Microscopic examination of sections of the marrow of one of the ribs showed immense number of lymphocytes and red cell together with myeloid giant cells in which the nuclei were arranged as twisted stellate or otherwise distorted masses of chromatin

**Lymph nodes** Microscopic examination of the lymph nodes removed from the brim of the pelvis revealed thickening of the capsule. Running downward from the capsule were narrow bands of dense connective tissue which in many instances encircled large islands of lymphoid cell. Among the lymphoid cells were to be seen group of small irregularly rounded hyaline bodies and numbers of giant cells with twisted nuclei of precisely the same type as were found in the myeloid giant cells in the marrow of the rib

**Splenic vein** The splenic vein showed large deposits of calcium lying in the muscle tissue. That at least one of similar deposits had so extensively replaced the tissues in the vein as to precipitate the rupture which was responsible for the fatal hemorrhage was shown by the extremely delicate rim of tissue which lay between certain of the calcific foci and the surrounding tissues

The microscopic examination of the other organs showed nothing of interest in the present connection

**CASE 3** The patient a man aged 38 was admitted to Bellevue Hospital complaining of rapidly increasing distention of the abdomen. He stated that 4 years previously a physician had told him that he had a large tumor in the left side of the abdomen corresponding to the location of the spleen. Operation was advised but this the patient declined because the mass was giving him no trouble. At the time of the patient's admission to Bellevue Hospital examination showed a large mass in the left side of the abdomen. The lower border of the mass was at the level of the anterior superior spine of the ilium and the anterior border approached the middle line of the body. The mass was firm to the touch. The abdomen was distended by fluid and para-

centesis was performed on several occasions. enormous quantities of clear yellow serum were removed at each tapping but the fluid reaccumulated with rapidity

The Wassermann reaction was negative and no anatomical signs of syphilis were detected clinically

The red cells numbered 5,800,000 the white cells 3,600. Of the latter there were 60 per cent polynuclear neutrophils 38 per cent lymphocytes and 2 per cent eosinophiles

**Lutopsy** (Abbreviated protocol) On opening the abdomen a large quantity of yellow fluid was released. The parietal peritoneum was strewn with tubercles. The spleen was greatly enlarged and weighed 1,150 grams. The capsule was slate gray in color and irregularly thickened. On section the organ cut firmly and was reddish in color fleshy in appearance and the substance was tough in consistency. The cut surface showed considerable increase in connective tissue in the form of delicate grayish streaks. Scattered here and there were small gaping vessels with smooth pale hyaline walls. Numbers of small angulated granular looking yellowish brown bodies were apparent to the unaided eye in different parts of the splenic substance. The splenic portal and superior mesenteric veins were partially occluded by attached grayish red thrombi. The liver weighed 1,375 grams and its surface was coarsely and irregularly lobulated. The cut surface showed connective tissue bands which were distributed in such fashion as to divide the substance of the liver into nodules varying from a few millimeter to several centimeters in diameter. The left testicle was firm in consistency diminished in size and on section was extensively replaced by fibrous tissue. The rest of the organs showed nothing of interest in the present connection

**Histology** In this case the histological changes in the smaller arteries of the spleen corresponded closely to those already described and consisted of thickening and hyalinization of the fibromuscular coat with calcification of its fibers in various localities and similar infiltration of the elastic lamina together with the deposition of amorphous golden yellow granule between the fiber. In some cases the periphery of the vessel was marked by small collections of red cells but a complete zone of intension was not observed in a single instance. The smaller veins were greatly dilated. In some of them the wall consisted of collections of swollen cloudy finely granular connective tissue through which numbers of delicate spindle shaped nuclei were dispersed in various directions. In others the venous walls were reinforced by pale hyaline plaques between which nuclear forms were arranged without any semblance of regularity. The ground work of the spleen was composed of minute connective tissue fibrils and great numbers of fibroblasts. This newly formed cellular connective tissue was arranged diffusely or in whorls and served almost completely to obliterate the venous sinuses and to

Th m t pt bl t rp t t f th fi d ppea t m  
t b th t lt f th d t b t th bo m w my l d  
g t ll h i b d h g j t t h l t d fil d t by  
h lymph d Th m rt f t m t b f g bl f  
h p es th lymph od Hod k d t bo m rr (s)  
d t m th m m ly p t th bo m rr (s)  
w f h th m m ly p t th bo m rr (s)  
my locy tes h h oc Hodgk d b t th d f ll







Fig 1 Case Showing the presence of the sclerotic and hyalinized arterioles with excessive infiltration of the fibromuscular and elastic coats by calcium and a peripheral zone of red cells. The golden granules (of silicate) are not represented. Above and to the left a dilated venule reinforced by a number of hyaline plaques. Diffuse sclerosis of the interstitium and dilatation of the venous sinus. To a fairly well preserved lymphoid follicle each in juxtaposition to a mineralized arteriole.

brick dust red in color and friable in consistence, yielding a fine grating sensation as the finger penetrated its substance. In the splenic tissue innumerable minute grayish fibrils were visible. The malpighian follicles were not seen. The smaller veins were gaping and their walls thickened. Moderate numbers of ochre colored bodies were present the largest approximating the size of the head of a pin.

Microscopic examination revealed abundant overgrowth of connective tissue in the form of fibrils and fibroblasts. The malpighian follicles were fairly numerous but small. Some of them were encircled by strands of connective tissue. The fibrous trabeculae were large and in places hyaline. A few of the arterioles showed the same extensive infiltration with calcium as has already been described together with scattered collections of amorphous golden granules or long narrow golden yellow plaques which were transversely fissured at frequent but irregular intervals. The periphery of the calcified vessel was marked by a fairly broad zone of densely packed red cells. Large and small hæmorrhagic extravasations were found at intervals. Some of these were partially delimited or were penetrated by extravasations collections of connective tissue fibrils and fibroblasts which resembled strands.

# DISCUSSION

In attempting to elucidate the histogenesis of the changes in the smaller arteries of the spleen one is apt to receive the impression that mechanical factors play a part namely that hæmorrhage is followed by disintegration of hæmoglobin and by the deposit of iron compounds in the hyalinized muscular and collagenous structures of the vascular coat. At the same time the circulation is impaired in such manner as to permit blood serum to escape through the damaged wall and calcium is precipitated and taken up by fibers which are prepared for its reception as a result of preliminary ironization. This view at least is in consonance with the observations of S Ehrlich (6) who determined the presence of calcium in ironized elastic fibrils in the immediate vicinity of hæmorrhagic foci and with the results of experiments by Sumita (7) who found that the deposition of iron precedes that of calcium not only in pathological conditions but



Fig. 1. (C) Stained section showing the arterial wall and surrounding connective tissue. The elastic fibers are stained black, and the collagen bundles are stained brown.

in the formation of bone in physiological circumstances the iron action is a sort of mordant. The same line of reasoning may be followed to explain the geographical distribution of the process of mineralization. For example it is recognized that retrogressive changes in tissue are a *sine qua non* for calcification and that in areas which are to become calcified the circulation is enfeebled. The change in the wall of the smaller splenic arteries and the compression of their lumina certainly fulfill the prerequisite. Although the vein showed sclerotic or hyaline change mineral deposit were not to be found in them in a single instance and this in spite of the fact that the structural alteration in the vein were of the sort that invite calcification. Since it is known that calcification is favored by diminution in and combated by the presence of carbon dioxide (8) it may be assumed that in the circumstances the increased carbon dioxide content of the venous blood and the preservation of the venous circulation combined to prevent the deposit of calcium in the wall of the veins.

The successive steps in the process of mineralization of the arteries seem to be susceptible of explanation on the basis

of histological appearances as developed by differential staining methods. The first change in the arterial wall is usually to be found in slight sclerosis of the subendothelial connective tissue although this is neither constant nor apparently important. The elastic fibers as shown by the orcein stain combined with Perl's reagent for trivalent iron reveal varying degrees of hyperplasia either in the form of thickened bundles of milk like wavy straight or broken fibrils running through in arc of the vascular circumference or surrounding the lumen. The fibrils may or may not show the presence of iron. In the spleen investigated by Sprunt where the process was apparently in an early stage of evolution the presence of iron in the elastic lamina of the arterioles was noticeable and to constitute the predominating change but in our case all of which appear to have been of longstanding we were not able to demonstrate iron in the elastic layer although calcification of the coat was practically constant. By means of hematocyan and eosin, microcrystosin and Van Gieson stain and even in unstained frozen sections it is to be shown that the thickening of the arterial wall is due to (1) the collagenous fibril and hyper trophy of the muscle elements with subsequent hyalinization of both. Many of the hyalinized fibromuscular structure yield in exquisite Russian blue reaction. Still others are impregnated with a substance which turns bluish or blackish with hematoxylin and which corresponds therefore to calcium. Lying between the more closely packed hyalinized structures are to be seen delicate strings of amorphous golden granule which are not only resistant to the common solvent but to such stains as were employed. It is possible that these granules represent a salt of iron perhaps an iron silicate or even a silicate of calcium. Where the hyalinized fibers are less compact the granular particles are arranged in clump and stand in striking contrast to the blackish deposits of calcium.

#### CONCLUSIONS

There is a distinctive form of massive splenomegaly marked by the occurrence in

the splenic substance of variable numbers of pinhead sized rounded oval or angulated bodies with a brownish or yellowish brown granular looking center and with or without a peripheral zone of red cells. These bodies which correspond histologically to sclerosis and mineralization of the smaller arteries are characteristic and readily identified and are distinct from anything familiarly encountered in the naked eye examination of the spleen. The substance of the spleen presents a reddish flesh like appearance is leathery in consistence and shows on section numerous small vessels whose walls are pale and thickened corresponding microscopically to venules in or around which hyaline deposits have occurred but which are immune from infiltration by mineral salts. Hemorrhages may be seen by the naked eye and histologically are found in various stages of organization. In addition the splenic substance is extensively replaced by the productive over growth of connective tissue of inflammatory origin.

The variety of splenomegaly described was encountered in syphilitic subjects only. The selective mineralization of the small arteries while differing from the changes commonly found in syphilitic vessels appears nevertheless to represent the deposition of salts in tissues already injured by syphilis. Whether identical changes occur in vessels in association with diseases other than syphilis remains to be seen.

Grateful acknowledgment is tendered Drs. John A. Hartwell and J. B. Ball of the surgical staff of Bellevue Hospital and Dr. O. H. Schultze of the District Attorney's Office in the County of New York.

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# THE TREATMENT OF RETRODISPLACEMENT OF THE UTERUS AT THE WASHINGTON UNIVERSITY OUT-PATIENT DEPARTMENT AND BARNES HOSPITAL

B F C SAGE MD ON

N YAKA  
F ILLINOISO U NEWELL MD Sr L CL MOSSOURI  
MOULSA

**R**ETRODISPLACEMENT of the uterus has been considered a clinical entity with symptomatology pathology and treatment distinct from and unrelated to other conditions as early as 1895 at this time Theilhaber (1) before the Seventh Congress der Deutschen Gesellschaft fuer Gynäkologie advanced the opinion that the symptoms which had been ascribed to retroversion i.e. backache abdominal pain hæmorrhage leucorrhœa bladder disturbance nervous dysmenorrhœa and sterility were in reality due to other condition associated with the retroversion of which the displacement was an accidental accompaniment As William (1) at Harvard pointed out in his article the paper by Theilhaber opened the question and paved the way for reinvestigation of the subject as his views met with a storm of opposition with the result that his ideas met with a confirmation from many sources Williams quote the affirming opinions of such writers as Buldy Boyce Kelly Mayo and Schroeder

From our work in the Washington University Out Patient Department and Barnes Hospital we also accept the criteria and will attempt to visualize our results with this work attacking the problem from four angles (1) simple retroversion (2) inflammatory retroversion — (3) with cellulitis (4) with salpingitis (5) acquired — (6) retroversion with new growth (7) resulting from child birth (8) congenital retroversion

Jacoby (3) at the New York Post Graduate Medical School and Hospital found that of 300 consecutive cases 56 per cent had retroverted uterus 15 per cent of which were uncomplicated by any other pelvic disorder 10 per cent of which had a posterior parametritis 55 per cent of which had diseased adnexa 3 per cent posterior parametritis and decensus 25 per cent decensus uteri

Sturmdorf (4) at the New York Polyclinic estimated that 18 per cent of the gynecological patients had retrodisplacement Barbour and Watson claiming that one fifth of these were of the congenital type John Van Doren Young (5) in his study of 6134 cases at St Luke's Hospital New York found that 50 per cent of the cases had purely mechanical retroversion leaving out of consideration all retrodisplacements due to posterior inflammatory peritoneal adhesions Williams (2) at the Boston City Hospital found that 30 per cent of 1000 cases seen there had retrodisplacements only 13 of which were operated upon for uncomplicated retroversion

Schroeder (2c) examined 145 medical patients complaining of no pelvic symptoms and found the uterus in anterior position in 75 per cent and retroverted in 25 per cent W J Mayo and (2d) While the normal position of the uterus in the majority of women perhaps 75 per cent is more nearly anterior than posterior it will be acknowledged that in at least 5 per cent and at various ages retrodisplacement exist Howard A Kelly (1c) found 1886 retroflexions in 13600 gynecological cases at the Johns Hopkins Hospital 415 uncomplicated (2 per cent)

At our clinic in four years time 5 per cent of the 3954 cases examined had a retrodisplacement of the uterus

We have then of this rather common condition seen in from 10 to 50 per cent of the gynecological patients four classes of retrodisplacement to consider

1 The *simple retroversion* due to disturbances of the normal mechanics physics or dynamics of the pelvic organs

The *inflammatory* in which the uterus is displaced by a pus mass and afterward drawn back by adhesions

3 The *acquired* as the result of injury or relaxation consequent upon childbirth with

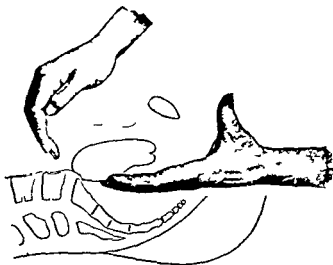


Fig 1 Bimanual replacement Raise the fundus uteri past the sacral promontory (Pryor's Gynecology)

subsequent subinvolution of the uterus and its supporting ligaments, or due to new growths of the uterus or adnexa

4 *Congenital* where the woman has no inflammatory condition or has never borne children

After having made the diagnosis of retro displacement and having determined how far back the body is the next point to determine is whether or not it is freely movable and the treatment adopted depends on whether the uterus is movable or adherent

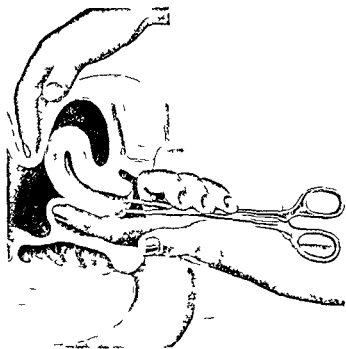


Fig 2 Drawing the uterus down with a tenaculum forceps to bring it within the reach of the examining fingers (Dudley's Practice of Gynecology)

With a movable uterus the first step is to replace the uterus in the proper position by bimanual manipulation as illustrated in the diagram (Fig 1). This oftentimes replaces the uterus. This is seen in recently delivered



Fig 3 Bringing the fundus uteri forward and pushing the cervix backward and upward (Kelly's Operative Gynecology)

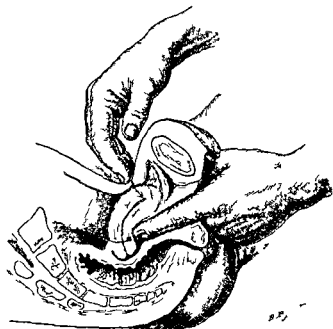
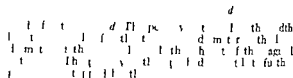
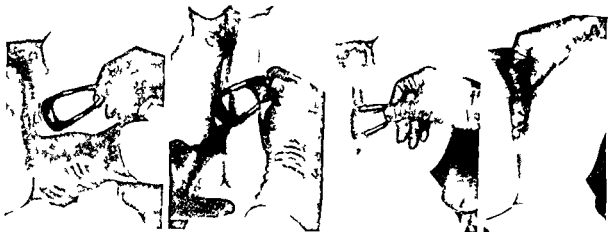


Fig 4 The uterus brought forward into position. This shows also the method of taking the backward flexion out of the uterus by bending it firmly forward over the vaginal fingers (Kelly's Operative Gynecology)



patient where the ovary luted in situ with it relaxed supporting structure has fallen down into the hollow of the uterus. If the corpus cannot be replaced by the ordinary bimanual examination a tenaculum is used to catch the cervix drawing down and upward which pulls the uterus away from the prominent ovary (Fig. 3).

The vaginal finger then runs the tenaculum (Fig. 3) as high as possible so that the abdominal finger precedes deeply into the back part of the pelvis can insert in rum the fundus which is being brought forward by the abdominal finger (Fig. 4) at the same time the vaginal finger is carrying the cervix backward and upward. All the maneuvers were described very fully in 1881 by Schultz of Jena in a monograph. He administered nitroglycerine to the patient where adhesion had to be broken up. With the patient's cooperation the manipulation can generally be carried out successfully without resorting to knee-chest posture and we condemn the method of replacing by a sound or retractor.

We find with some patients that they are too nervous with the uterus and adjacent structures too tender to permit the manipulation necessary for replacement on their first visit to the clinic so they are dismissed giving them a glycerine tampon to be removed the

next day with instruction to take hot vaginal douche one half hour twice daily keep the bowels open and take knee-chest posture 15 minute twice daily. Such treatment at home diminishes the pelvic tenderness very much and at the next examination the uterus can generally be brought forward.

When the uterus is brought forward we select a proper fitting Hodge pessary No. 4 or 5 and insert this as the most convenient and efficient device to keep the uterus in place as illustrated in the various stages in Figure 5. Figure 6 shows the pessary in place holding the uterus in its forward position.

*The instruction to the patient caring a pessary.* The patient is then allowed to get off the table walk around and squat down to see if the ring gives her any discomfort if not she is asked to report to the clinic one week later if the pessary is proving satisfactory but sooner if it protrudes or slips out of position. If the uterus is in place and the patient is having no discomfort and the pessary is in proper position it is urged that it will prove satisfactory right along and she is to report then every month taking a cleansing douche every day so that no discharge can accumulate on the ring causing a concretion that might prove irritating. Then

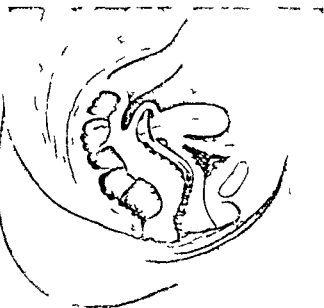


FIG. 6

FIG. 6 Pessary in place. After the pessary is in place the patient should be told to press down as if at toilet to see if the pessary is accurately fitted. There is no objection to introducing the bivalve speculum and carrying out any cervical, vaginal or intra-uterine manipulation or intra-vaginal packing with glycerine and gauze. The presence of the pessary does not interfere with these therapeutic procedures.

When the patient returns a month later the pessary is removed, cleansed and the vaginal walls and vault inspected to see if the long continued pressure has caused any ulceration. If such is the case or if injurious pressure on the wall is indicated by a distinct groove or ridge with infiltration the pessary is left out. The patient is packed with one glycerine

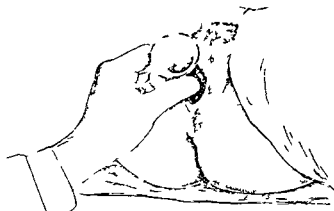


FIG. 8. Ferring pessary in the vagina

soaked tampon with a second dry one inserted afterwards with the patient in knee chest posture. It is good for the patient to assume this position night and morning. It is very advantageous where patient complains of downward pressure in the pelvis.

The patient is told that the wearing of the pessary does not curtail her activities in any way, does not interfere with coitus, as in some cases of sterility they are used principally to increase the chance of pregnancy and that if pregnancy should develop she is to continue wearing it until the uterus has become large enough to prevent its sinking back into the pelvis.

If the uterus will not stay up after using the pessary for six months we consider that more radical means should be employed and send the patient to the hospital for the operation best suited for her case.

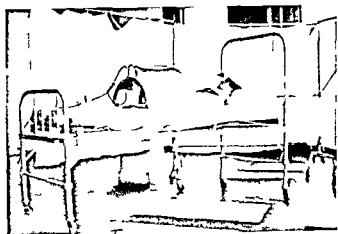


FIG. 11. Electric light cabinet, basin, hospital bed.



FIG. 13. Patient in the T. del. n. l. u. g. p. t. th. rub. b. l. a. n. e. t. e. d. n. a. m. a.





Fig. 8. Hot water bag treatment.



Fig. 9. Trendelenburg position.

If the retroversion is of the second class that is due to some pelvic inflammatory trouble the treatment is directed primarily to the inflammatory process and the displacement is corrected only incidentally. The adhesions may have resulted from gonococcal infection, puerperal infection, acute appendicitis, tuberculosis, improper fitting pessaries.

If the patient can afford to enter the hospital we treat her there with hot douche 116°F twice a day and electric bakes one half hour twice daily, increasing to one hour twice daily with the electric light cabinet as pictured in Figure 8, using a Ferguson speculum in the vagina (Fig. 9) so that the heat can more effectively reach the inflammatory mass. The temperature under the cabinet is from 100 to 115°. After two weeks of such treatment most inflammatory masses if they are in the tubes or parametrial cellular tissues will melt away, the pelvic tenderness will likewise disappear and then the body of the uterus becomes more movable and treatment for the displacement may be instituted.

We advise these patients who can only be seen in the clinic to take their hot douche at home lying on their douche pan having some other member of the family refill the bag with as hot water as possible so that they use 10 or 12 bags full twice daily. They are tamponed in the clinic and carefully observed to see when the inflammatory masses have improved enough so that the adhesion can be broken up and the corpus replaced and pessary worn if need be.

In case where posterior cellulitis seems to be the most aggravating symptom the douches are strongly urged but at the clinic we put the patient on the mercury bag treatment. The patient is put in the Trendelenburg position (Fig. 9) and the empty rubber bag inserted in the vagina. Then five pounds of mercury are poured in through a funnel, a clamp applied to the mouth of the bag, the free end brought up over patient's abdomen where counter pressure is brought to bear by a 5 pound bag of shot placed just over the symphysis and lower abdomen (Fig. 10). The patient is allowed to stay in this position one half hour, returning twice or three times a week. This weight in the posterior fornix tends to iron out cellular infiltration and stretch the inflammatory adhesions from the sacrum to the fundus (Figs. 10, 11). If the patient does not respond to this treatment by the end of two months so that it can be plainly seen that the mobility of the uterus is increased they are in turn given a letter of admission to the hospital for correction by some operative procedure.

The mercury bag treatment was first introduced by Freund in 1897 (7). Originally the technique was as follows: A condom was introduced over a round speculum, shot poured in and the speculum removed leaving

the shot in place from 2 to 10 or 16 hours with counter pressure on the abdomen by placing a bag of shot weighing 1 or kilograms. This method was first used by Funke Freund's assistant and independently by Pinkus. The method was popularized by Halban in Schruta's clinic who was the first to use the mercury in a colpeurynter (as we use it in this clinic) placing the patient in the Trendelenburg position. He pointed out that he could use more weight in the colpeurynter than Funke could by means of the condom.

The Trendelenburg position favored the return flow of the blood while the weight therapy by pressure on the pelvic organs, both from abdomen and vagina produced enough compression of the vessels to give a venous hyperemia causing absorption.

Pinkus pointed out that you could use this therapy just as well by raising the foot of the bed. He also devised a combination of bags where you could release some of the mercury by letting in air, thus the circulation was not depleted as suddenly and the patient could return home with the air colpeurynter in place giving in addition in ambulatory form of treatment.

This mercury bag then (1) relieved the pain by stretching the adhesions as shown in Fig. 11 having quite the similar effects as massage which is used quite intensively in the European clinics and is ( ) better in numerous cases being simpler and is less dangerous not producing the discomforts that massage sometimes causes in psychic patients. We do not use massage in this clinic.

So the mercury bag method of treatment is given a trial in all affections of the parametrium as it causes inflammatory edema to disappear loosens structures up better so that a more exact diagnosis can be made of adnexal masses. Careful use of the mercury bag can also be used in double pyosalpinx using at first small amounts one fourth to one half pound causing a marked decrease in the tenderness. This method is especially valuable in ironing out old scars running from cervix into parametrium. Lately we had such a case where the patient at her former delivery had her cervix incised by the attending physician to hasten the delivery leaving her

with a definite band of scar tissue that was extremely tender on any manipulation but which responded very nicely to the constant and equal pressure exerted by the 5 pounds of mercury.

We have also a *third class of retrodisplacement* to consider those due to new growths of the uterus or adnexa or those following child birth as the result of a relaxed pelvic floor with some decensus and retrodisplacement or due to subsequent subinvolution of the uterus and its supporting structures. In our table of cases are seen many instances of incomplete abortion where a curettage with baking hot douches and possibly a ring corrected the condition. In other cases anterior suspensions had to be done generally by shortening the round ligaments by pulling them through the rectus muscle and sewing them together underneath the aponeurosis or by the Venable operation. Where the perineal floor was relaxed a perineorrhaphy was done to give the proper support from below and if the cervix needed repair this was done routinely. Whenever we could have the patient become pregnant again she was closely watched to see that the growing uterus spontaneously corrected its position and then in her puerperal state every measure was used to keep the uterus forward—but if these measures did not suffice operative measures had to be resorted to.

It is not within the scope of this paper to discuss the different operations for retroversions there were 131 papers written on this subject in 1913 alone. Operative gynecologic records show over a hundred detailed operations for the correction of retrodisplacement and Baldy states that the possible number of retrodisplacement operations performed in this country is limited only by the number of females in existence.

We have treated 1 cases with dilatation curettage and pessary 16 cases with a supravaginal or complete hysterectomy 38 cases by anterior suspension operation—Gilliam Crossen Venable Mann Webster Montgomery technique this series of cases also including two instances where myomectomy for fibroid nodules was done 7 cases with an interposition operation and 1 case

with a perineorrhaphy with later types try to correct the displacement. Two cases of pregnant uteri retrodisplaced corrected themselves spontaneously as the uterus grew larger.

For the choice of operations well suited to the case we followed Croxson's (8) suggestions as closely as possible as outlined in the May number of *Journal of Missouri State Medical Association* 1916. A Dr McEwan (9) of London has shown most of the cases fall under four heads: (1) treatment in the childbearing period; (2) when uterus replaceable; (3) when uterus fixed; (4) backward displacement after menopause; (5) backward displacement associated with uterine and ovarian tumor; (6) backward displacement of the gravid uterus.

Attention should be called to Reynolds' (10) idea as an expedient for radical cure of the acquired type of retroversion occurring as a result of a fall or during puerperal relaxation. He arranges the puerperium so that the supporting structures undergo a complete involution while the uterus is held in an extreme forward position that is on the tenth or fifteenth postpartum day when the uterus is too large to retrovert. The body is thrown into a strong introversion by manual manipulation and a carefully fitted hard rubber pessary made to hold it there. Then very hot vaginal douches are given for 10 minutes twice daily causing a very rapid involution so that within a week the original pessary is generally too large and a second ring must be put in on the tenth or fourteenth day changing to smaller ones as necessary until the uterus is little above normal size. Necessarily such practices must be done with a care and by those familiar with fitting pessaries to the individual cases. We have tried this method in the hospital and find it very satisfactory.

When we see a retrodisplacement in a woman who has had no inflammatory condition and who has not borne children we must consider the condition congenital and the retroversion may be said to be the normal position of the uterus for that individual—so is usually symptomless and requires no treatment. Barbour and Watson (11) estimated one fifth of the retrodisplacements as congenital. Sturmdorf (4) of the New York

Polyclinic by his application of the lumbar index estimates one half of all cases of retroversion complicated and uncomplicated as congenital. He claims this index is the only pathognomonic factor that is constant accurate enough to apply and which should constitute a routine part of every gynecological examination. This index is the distance in millimeters from the deepest point of the hollow between the dorsal and sacral concavities to a ruler connecting the two points of the spine. This measurement in a large series of cases varied from 1 to 45 millimeters in excess of 45 millimeter indicating a pathological lordosis—the kangaroo type of posture in index of 30 millimeters or less—the gorilla type of posture in which is seen the congenital retroversions which may be positively predicted in nearly every case prior to its biminiar verification. The cause for this displacement is a congenital retroversion of the entire pelvis with resultant compensatory distopia of its contents there is a flattening of the sacrovertebral angle regularly evidenced by a corresponding obliteration of the normal lumbar curve and the measure of it resultant approximation to the verticillate timing an index of 30 millimeter mark the extreme minimum compatible with normal introversion from 25 millimeter down the existence of congenital retroversion. He argues that every abnormal pelvic tilt must create a correspondingly abnormal uterine tilt so that when there is an upward and backward rotation of the pelvis the pubes and lower sacrum are elevated the latter forming the posterior tent of the upper wall of the pelvic cavity necessarily altering the mechanism of the uterine ligament their horizontal pull holding the uterus back against the deepened sacrum. Likewise the intra-abdominal pressure is inadequately deflected through the intestinal coils against the anterior surface of the uterus causing the retrodisplacement.

Treatment of such cases must be on mechanical and orthopedic principle.

A uterus congenitally retroverted before conception will invariably resume its retroverted position after delivery when the demonstration of a minus index will reveal

the congenital nature of the displacement to the exoneration of the accoucheur

The following summary shows the duration of treatment and results obtained in 23 cases of simple retrodisplacements 48 cases of acquired as result of childbirth and new growths and 44 cases with inflammatory complications 1 with salpingitis 3 with cellulitis — as taken care of in the clinic. The summary includes the complaints ages pelvic findings and treatment of some hundred cases in the hospital

Table have been compiled of 103 hospital cases stating the principal complaints pelvic findings treatment and age of the patients. One hundred and seventeen clinic cases were abstracted showing the length of time the patient complained the type of retrodisplacement treatment duration of treatment and the results. The length of time the patient complained varied from one month to eight years. There were

Thirty five cases of retrodisplacement due to inflammatory cellulitis

Twelve cases due to the adhesions of a salpingitis

Forty five cases acquired following childbirth

Two cases acquired on account of mechanical pressure exerted by new growths such as ovarian cysts fibroid nodule in anterior surface of uterus

Twenty two cases of simple uncomplicated retrodisplacements

The treatment used in the clinic was the glycerine tampon mercury bag reduction by Kustner's maneuver persist until corpus would run forward or in many cases until the patient became pregnant

The quickest results were obtained in three or four weeks that is reduction of the displacement after being treated that length of time with the tampon and mercury bag

The average length of time the clinic cases were treated was three to four months. If they did not respond to these palliative measures in six or seven months they were referred to the hospital for the performance of more radical measures—some operative interference

The most common symptoms of the cases seen in the hospital were pain in the lower abdomen dysmenorrhœa menorrhagia backache bearing down pains leucorrhœa sterility frequent abortions constipation sacral backache metrorrhagia pain in either of the lower quadrants of the abdomen and pain in the rectum amenorrhœa

Associated pelvic findings besides the displacement were relaxation of pelvic floor chronic salpingo oophoritis chronic metritis chronic posterior pelvic cellulitis fibroid nodules in the corpus laceration of the cervix second and third degree perineal lacerations ovarian cysts marked endocervicitis with accompanying erosion hemorrhoids incomplete abortions prolapse of the uterus

cytocele and rectocele visceroptosis rectovaginal fistula

Necessarily the choice of operations was governed by the findings. More anterior suspensions by shortening the round ligaments by the Gilliam Crossen technique were performed than any one other procedure. When the patient had some adnexal involvement she was bled and douches until the displacement could be properly taken care of

When the uterus was left curettage was almost routinely employed to scrape away the thickened endometrium which usually showed a glandular hyperplasia

The age of the patient determined many times what was done with the adnexal pathology. If it was found that the blood supply would be too markedly interfered with to do any plastic work in the younger individual and that both tubes and ovaries had to be removed at the time of the supravaginal or complete hysterectomy the patient after her discharge from the hospital was asked to return to the clinic for the administration of corpus luteum which was given in 1 cubic centimeter doses intravenously two or three times a week. This organotherapy generally controlled the accompanying symptoms of an artificial menopause. The age of the patients varied from 1 to 56. The interposition operation gave very pleasing results in the women past the childbearing age who had some cystocele or prolapse accompanying the retrodisplacement (Wertheim Watkins technique)

Vaginal hysterectomy was performed in those cases where the patient had no history or findings of appendicitis or adnexal inflammatory disease was past the childbearing period or desired no more children

It might be worth adding that it was always routine to get the patient to sign an operating permit which we feel saved us perhaps several lawsuits. The form used was that suggested by Croson

I hereby give permission for the performance of the desired operation and any such additional work as found necessary at the time of operation

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*Report* November 28 1911 five years after operation Patient in good health no gastric symptoms can eat anything

*Case 3* Female age 1 gave a history of gastric disturbance pain and epigastric distress for several months with progressive weakness and loss of flesh Recently vomiting had been so persistent that little nourishment was retained

*Physical examination* showed an indefinite mass in the epigastric region No gastric analysis was made Roentgenographic examination demonstrated a carcinoma of the pylorus with marked retention of the bismuth meal

*Operation* St Luke's Hospital September 12 1912 A carcinoma of the pylorus was found and about a third of the stomach was resected by the Billroth II method The patient vomited small quantities of bile for several days after operation and there was some drainage from the wound otherwise convalescence was normal

*Pathological report* No. 100 Carcinoma of the stomach Nodes not involved

*Report* December 1 1917 five years and three months after operation states that patient is in fair health although she is over 6 years of age She has symptoms of arteriosclerosis but no gastric disturbances or signs of recurrence

Beside the fact that these three patients have remained free from recurrence for a period of five years or more after operation each of them presents one or more points of interest

Case 1 is of special interest because notwithstanding the presence of a tumor of which the patient was herself conscious for eighteen months before operation and although microscopic examination demonstrated scirrhous carcinoma the tumor was not adherent to the surrounding part the operation was not technically difficult and the lymphatic glands in the pyloric region although enlarged were not the seat of malignant metastases

Case 2 presented several unusual conditions First the age of the patient as thirty is a rather early age for the appearance of carcinoma of the stomach Second the proof both from the history and the pathological findings of the development of carcinoma in the edge of a pre-existing ulcer Third the evidence of an old perforation which had been closed by adhesions to the liver the capsule of which formed part of the new base of the ulcer Fourth the technical difficulty of the stomach resection necessitating a

resection of that part of the liver adherent to the base of the ulcer

The chief interest in Case 3 was the age of the patient 71 years and demonstrated that although the patient may be emaciated and weakened as a result of the pyloric obstruction in the absence of metastases age is not necessarily a contra-indication to a radical operation

Having remained free of gastric symptoms for five years or more it may reasonably be expected that there is a good prospect of permanent cure in these patients They represent the end results in a small series of cases of carcinoma of the stomach in only eleven of which an excision could be performed Nine were pylorotomies with partial gastrectomies Of these two died one with a complicating postoperative embolic gangrene of the leg In one other case I believe that a contributing cause of death was heat stroke as the operation was performed on one of the hottest summer days when the temperature was such that better judgment should have deferred any such extensive operation on a patient in poor general condition Three patients lived for seventeen thirteen and six months respectively after operation dying of recurrences but all having gained in weight and improved in general condition and having been relieved of pain and vomiting for a considerable time after leaving the hospital One patient operated on eighteen months ago was relieved of symptoms and gained twenty eight pounds in weight but it is too early to foretell the ultimate result although a recurrence is probable In one case excision was performed without pylorotomy with a fatal result In another patient a resection at the cardia ended fatally

Conclusions based on such a small series of cases would be of little value but the fact that four cases out of eleven are alive three of them without symptoms for five years and one for fifteen months after operation should do something to dispel some of the gloomy prognoses and encourage further effort

Progress in the improvement of the treatment of any disease makes its greatest advance with increased knowledge of its etiology and while the cause of cancer is still to be

discovered if we knew the actual relation-ship of ulcer of the stomach to cancer of that organ it would perhaps modify our therapeutic procedure. It is generally conceded that ulcer is a factor in the etiology of gastric carcinoma but to what degree is a matter of the widest divergence of opinion. The evidence is exceedingly contradictory. On the one hand are the statistics of the large surgical clinic based on evidence derived from pathological examination of material removed at operation. On the other hand is the clinical evidence based by many internists based on the absence of previous history of ulcer and backed by the fact that postoperative history shows that after gastrectomy for ulcer cancer occurs in only 1 to 5.5 per cent (Kuttner, 3 per cent; Kocher, 3 per cent; Fetter, 3 per cent; Cresot, 3 per cent; Billroth, less than 1 per cent).

The strongest evidence of the development of cancer from ulcer comes from the pathological department of the Mayo Clinic where with the passage of time and increased experience the belief seems to be increasing. Thus Crile in 1906 wrote that 15 per cent of all gastric ulcers had in ulcer bed while in 1909 Wilson and McCarty wrote that 71 per cent of gastric ulcers manifested sufficient gross and microscopic evidence of ulcer to warrant labeling them cancer developing on previous ulcer and finally in 1914 Wilson and McDowell wrote "It seems probable from the clinical and pathological evidence of this clinic that gastric cancer rarely develops except at the site of a previous ulcerative lesion of the mucosa."

Of course the obvious answer to these conclusions by those who disagree with them is to point out the work of Bullock who has shown that under the influence of chronic irritation it is possible to produce lesion in epithelial structure which resemble malignant tissue microscopically while removal of the source of irritation is followed by a retrogression and disappearance of the suspicious structure.

The report from other large surgical clinics while not all showing so high a percentage as the Mayo Clinic still show a far higher

proportion than claimed by most internists. Thus Hobson in 1904 stated that in 593 per cent gastric ulcer preceded cancer. Moynihan in 1909 reporting on one hundred cases of gastric cancer states that approximately two thirds had a history of previous ulcer. Rodman in 1908 50 per cent. Furr in 1910 stated that examination of specimens removed for chronic ulcer showed that 26 per cent showed either beginning or moderately advanced cancer formation. Kuttner in 1910 wrote that 43.4 per cent of specimens removed with the operative diagnosis of chronic ulcer proved to be carcinoma on microscopic examination. Buchet in 1917 wrote that in 80 per cent of his gastric cancer case the cancer had developed on the basis of an ulcer and the ulcer had seldom been recognized.

The evidence however when based solely on the previous history of the patient is far lower. As a rule the figures are published by internists or gastroenterologists. Thus Friedenwald in one thousand cases of cancer of the stomach found only 3 per cent that gave a history of previous digestive trouble and only 7.3 per cent in which the history could be interpreted to mean chronic gastric ulcer. Lockwood gave 7 per cent Stockton between 5 and 15 per cent Lind 12.5 per cent Timhorn less than 5 per cent and Boissac. Such a metamorphosis is not to be numbered among the frequent occurrences. At the same time must be included the statistics of two surgeons Kuttner who in 1914 reporting on eleven hundred stomach cases treated in the previous eleven years two thirds of which were cancer found that but 15 per cent of the latter had preceding stomach symptoms and of these he was unable to determine whether they were ulcer gastritis or achylia. Peck in an analysis of 5 cases of gastric carcinoma treated in several of the large New York hospitals in the five or six years previous to 1917 found that only 10 per cent gave definite long histories of digestive disturbances or digestive ulcer.

There may be included here the theory of several German pathologists Hauser, Cramer and Aschoff who advance the idea that the explanation of the pathological and

ing of carcinomatous changes in the edge of a stomach ulcer is rather that the carcinoma precedes the ulcer and causes it by plugging the nutritive vessels with subsequent necrosis and digestion of the carcinomatous tissue. That this pathological process may occur is demonstrated by a report in an article by Wlensky and Thalheimer in which extensive metastases of the regional lymph nodes were found apparently secondary to an ulcer all evidence of carcinoma in the edges and base of which had disappeared. Their article is based on the microscopical examination of 48 ulcerated lesions of the stomach including 39 chronic ulcers, 7 ulcer like carcinomatous lesions, one mixed lesion and the above mentioned case of ulcer with regional carcinomatous lymph nodes. The most important finding in their examination was that 18.7 per cent of the ulcer like lesions were found to be carcinomatous microscopically although the fact that they were malignant could in no way be determined by gross examination and as a result of their examination they believe that these ulcers were probably malignant from the start and that necrosis and digestion of the carcinomatous tissue is responsible for the belief that cancer is frequently grafted on the ulcer base. This in connection with the findings of Fay and Kuttner is of great interest.

Is there any way in which this wide difference of individual opinion can be explained and which theories are most probably correct?

Every surgeon is familiar with the influence of irritation, ulceration and precancerous changes in other parts of the body as an etiological factor in carcinoma formation, for example the lip, tongue, cheek, abdominal wall, sigmoid, etc. Therefore why is it not probable that an ulcerative process precedes the carcinoma of the stomach as well?

One theory of the development of carcinoma from an ulcerative process is that in the course of healing some of the epithelial cells are cut off by the contracting connective scar tissue and taking on a new process of growth due to irritation or some unknown cause these cells proliferate and develop carcinoma. It is in the edges, not the base of the chronic indurated ulcers that this

condition is found. If the destructive ulceration prevents the inclusion of such cells or if healing occurs without such inclusion there is no reason why cancers should develop. There is also the theory that an abrasion with circulatory disturbance makes possible the implantation and subsequent growth of some living cause of the carcinomatous growth. Mayo is of the belief that the ingestion of hot fluids by civilized man is a probable explanation of the cause of gastric carcinoma.

As to previous history, the severe pain of gastric ulcer is usually associated with hyperacidity. Frequently alkalis relieve the pain. We know that ulcer of the stomach may exist without hyperacidity or hyperperistalsis. We know that the stomach wall can be incised and sutured without pain in the performance of gastrotomy or gastroenterostomy after local anaesthesia of the abdominal wall. Is it not possible then that a more or less passive ulcer of the stomach if one may use such a term may exist without hyperacidity or much pain or other gastric symptoms in the absence of retention? If in the process of repair somewhere in the edge of the ulcer there is an inclusion of epithelial cells or due to chronic irritation or whatever the cause may be carcinoma develops then only with the appearance of retention more extensive ulceration, pain, vomiting, hæmorrhage or the appearance of a mass is the diagnosis made. That is to say the absence of a long standing history of stomach trouble is not proof that ulcer did not precede carcinoma.

Furthermore the difficulty of a correct diagnosis of gastric ulcer in some cases must be recognized. While in the majority of cases the history, physical signs and laboratory tests make a positive diagnosis possible every surgeon with any considerable gastric experience must have operated after the most careful examination and confirmation of the diagnosis by the best of internists or gastroenterologists and still failed to find an ulcer. The symptoms having been caused by hyperacidity, pylorospasm, cholelithiasis or other lesions. On the other hand in patients giving a comparatively short history of gastric disorder an ulcer of such size and induration



may be found that it is far to assume that it has existed for a considerable time. Also while a previous history of gastric disturbance may be elicited in the majority of cases of perforated gastric ulcer not infrequently the ulcer may proceed to perforation without causing sufficient pain or other gastric symptoms to cause the patient to seek advice or medical treatment. Again an ulcer may exist then heal and a new ulcer or carcinoma develop at a different site.

In a patient upon whom operation was performed about eighteen months ago an extensive ulcerating carcinoma of the pylorus was found the carcinoma cell infiltrating the liver substance which was resected with the tumor. The history in the medical book between three and four months and was only one of indigestion the patient stating that he never had any pain in the epigastrium. Previous to operation a tumor was easily palpable. Whether this carcinoma originated in a callous ulcer or in a papillary adenoma or second tumor of which variety was found in the resected portion of the stomach about two inches from the carcinoma it is impossible to tell. It is however difficult to believe that this extensive process had only been developing for less than four months during which the symptoms of indigestion had been present. It is also of interest that the patient absolutely denied ever having suffered any pain.

On the other hand I recently operated on a patient with an hour glass constriction of the stomach due to an ulcer of the lesser curvature who showed no sign of carcinoma although the symptoms of ulcer had been present at intervals for sixteen years and the physician who had treated her states that she had symptoms of a small perforation sixteen years ago. This latter case merely demonstrates the long time an ulcer may have been present with periods of quiescence without becoming malignant.

May not some of these facts furnish an explanation as to why the internist fails to elicit a previous history of gastric ulcer in a large number of his cases of carcinoma of the stomach and if so that the surgical statistics based on operative gross and

microscopical examination of the specimens removed are probably more nearly correct? Particularly so where the work of Wilson and McCarty has enabled them to examine the early case in which the cell proliferation in the edge not the base of the ulcer is just beginning.

The fact that such a small number of cases of carcinoma of the stomach occur after gastrojejunostomy for ulcer offered as proof of the failure of malignant degeneration is difficult to explain but is not absolute proof. Cancer of the stomach and of the large intestine is common of the small intestine very rare although postpyloric ulcer is more frequent than prepyloric ulcer. Of course the stomach and intestinal contents remain longer in the stomach and large intestine than in the small intestine and are less fluid and therefore traumatism and irritation of the mucosa more likely to occur. It is in those portions of the stomach and of the large intestine the pylorus rectum and flexures of the colon—where trauma or ulceration is most frequent that cancer is most often found. Why however is carcinoma of the duodenum so very rare when ulcer is so common or does carcinoma so rarely occur elsewhere in the small intestine? May it be that some secretion contained in the small intestine has a protective or inhibitory action on the cancer development and that its entrance into the stomach after gastrojejunostomy also has an inhibitory influence on the promotion of a malignant degeneration of the gastric ulcer for which the gastrojejunostomy was performed. The theory has been advanced by Greslet and while considered alone does not seem as probable as that carcinoma does not frequently follow ulcer but considered with other evidence is not inconceivable particularly when the Wilson and Thalhimer case is considered.

As to the theories of Hauer and Cruber and Aschoff that the ulcer is secondary to the cancer while it is true that all carcinomas of the gastrointestinal tract ulcerate in an extensive cancer the evidence pathologically of its origin in an ulcer would largely be destroyed by the carcinomatous growth

Moreover their theory absolutely disregards those cases of old callous ulcer in which a malignant process is just beginning in the edge of the ulcer. As an illustration of this Mathews reports a case in which a callous ulcer was excised by a pylorotomy. Pathological examination was made and a diagnosis of callous ulcer reported. Subsequent examination of the glands removed demonstrated carcinoma and a later examination of sections cut from the edge of the ulcer showed beginning carcinoma in an area which although very small itself had already resulted in metastases in the lymph glands. Perhaps this and the theory of the preceding paragraph are answered by the sloughing and digestion of the growth as Wilensky and Thalheimer believe account for the findings in their studies.

However if this is accepted how can we account for the small number of cases of cancer developing after gastro enterostomy for ulcer if such a large percentage of apparent ulcer as 18 per cent as shown by their series is really carcinoma or 43 per cent of Kuttner's series or the 6 per cent of Payr's series? One obvious explanation is that it is recognized by surgeons that gastro enterostomy alone without excision is not curative of ulcers high on the lesser curvature and posterior wall of the stomach and is therefore not done in these cases but this does not account for the large number of carcinomata beginning on the lesser curvature near the pylorus.

Coffey in an admirable review of the subject of gastric and duodenal ulcer states:

It seems that there is a heavy burden of proof on the advocates of the theory that cancer usually develops on an ulcer base to show that the precancerous ulcer was not really cancer from the start.

This is a fair statement and it is acknowledged that the proof is difficult but always remembering that the claim that a large percentage of gastric carcinoma originated in ulcer should not be interpreted to mean that a large percentage of ulcer cases necessarily develop cancer it seems in review of the foregoing facts and theories certain conclusions are justifiable.

## CONCLUSIONS

1 The conclusions reached by the pathologists of the Mayo Clinic where probably more material from excisions of ulcers and early carcinoma are examined with the greatest care than anywhere in the world should carry great conviction even considering the work of Bullock.

The considerable but not troubled reports of cancer in a small area of the edge of an old ulcer is proof positive that the change does occur confirming the above statement.

3 The evidence that cancer develops from chronic irritation and ulcers in other locations adds probability that the same metamorphosis occurs in the stomach.

4 The agreement of those opposed to the theory of carcinomatous degeneration in a large percentage of ulcers that a previous ulcer history may be obtained in from 5 to 17 per cent together with the facts that diagnosis is not always certain and that ulcers may perforate without previous symptoms and that a long ulcer history is not contrary proof would seem at least to make it a fair presumption that ulcer preceded cancer in a larger percentage of cases than their figures indicated.

5 The results after gastro enterostomy are it seems to me the strongest presumptive evidence against carcinomatous degeneration of ulcers but an explanation is not inconceivable based on the rapid healing which usually occurs in ulcers near the pylorus after operation and the theory of a possible inhibition of cancer formation after gastro enterostomy according to the previously mentioned theory of Gressot on the possible digestion of the sloughing carcinoma and remembering the claim that a large percentage of cancers originate in ulcers does not mean that a large percentage of ulcers necessarily become malignant.

If these facts and theories then make it seem probable that ulcer precedes cancer in a fair proportion of cases and that a considerable number of cases cannot be differentiated either by history or gross examination what practical bearing has it on the following facts which are not contested? (1) The mortality without operation is 100 per cent. (2) The

percentage of deaths from cancer of the stomach in the total death rate is one per cent (3). More than 50 per cent of all cancers occur in the stomach (4). Of late year the statistics at the large clinic show an operability of 38 (Mayo) to 39 (Bloodgood) per cent of cases coming to the surgeon for operation.

In addition to combating the idea that there is no hope, even a surgical cure of cancer of the stomach and of doing everything possible to make an early diagnosis of cancer which is admittedly difficult there is, I believe, an obligation resting on both the internist and the surgeon. A patient with gastric symptoms which do not improve rapidly under treatment should have every means of diagnosis employed to determine the nature of the lesion present. If the diagnosis of ulcer of the stomach can be made and the symptoms cannot be soon cured by medical treatment or if they recur after treatment operation is indicated. If the patient is over forty the probability of cancer is greater and therefore in such patient a careful examination is imperative and the X-ray is the greatest assistance in diagnosing the cases of cancer of the pylorus where operative treatment is most successful and if such cases are referred for operation when the diagnosis is a probable and not a positive one, our operability statistics should be better than 38 or 39 per cent. In addition unexplained secondary anemia in a patient over forty should have a careful roentgenographic examination of the gastrointestinal tract.

It also devolves upon the surgeon to realize that gastric ulcer are potentially cancer and that a diagnosis made copiously in the early stage of malignant development cannot be made therefore in old callous ulcer in a patient of the cancer age should when possible

be excised. If small and not believed to be malignant and only then it may be destroyed by the cautery method and a gastroenterotomy done or else a transgastric resection or pylorotomy performed whenever it seems even possible that carcinoma has been at any point in the margin of the ulcer. Thalheimer and Wilensky after investigation of the subject conclude that when the regional lymph nodes are not involved and there are no demonstrable metastases in small carcinomata of the stomach situated elsewhere than at the pylorus the malignant process is so limited in extent that local resection at a distance of 1 or 2 centimeters beyond the macroscopic limits of the tumor will in the majority of instances remove the entire tumor.

It has been argued that consistency in those who believe in the frequency of malignant development of ulcer should result in the resection of all ulcers of the stomach but the small percentage of malignancy developing after gastroenterotomy would seem to show that resection is not necessary in all cases if carcinoma has not already developed.

If then the etiologic factor of ulcer as a cause of cancer and the difficulty of differentiation microscopically between callous ulcer and cancer even at operation is borne in mind by both internist and surgeon and the proper course pursued in respect to painstaking diagnosis in gastric case earlier operation recommended in radical procedure carried out when indicated. I believe that the operability of cases coming to the surgeon will be better than 38 to 39 per cent our mortality will be still lower and the percentage of final cure higher while the total death rate from cancer of the stomach will be materially lessened.

# DEPARTMENT OF TECHNIQUE

## A SIMPLE AND EXPEDITIOUS METHOD OF PERFORMING THE ABDOMINAL INCISION

By I BROOK F BLAND M D PHILADELPHIA

A t t P f f Gy l b y J H M d I C H g Cy l a t t St J pl H pt l

THE favorable comments of visiting physicians upon the method we have employed during the last three years for opening the abdominal cavity have been so frequent that I feel justified in presenting an outline of the procedure. We have not the temerity however to claim this as a new step in surgical technique but we have never seen the method employed nor have we been able to find it described in the literature. This operation was first performed in my presence by Professor E F Montgomery about three years ago and thereafter it was utilized exclusively by him in the clinics of St. Joseph's and Jefferson hospitals. For a long time his associates failed to appreciate its merits and hesitated to adopt the method.

The advantages we claim for the operation are that it is distinctly a time saver because it economizes movement and effort on the part of the operator and therefore contributes to the safety and comfort of the one most concerned the individual operated upon.

With the exception of the knife and the fingers of the surgeon no instruments whatsoever take part in the incision. The tooth forceps universally used to pick up the aponeurosis and the tissue forceps or hemostats still routinely employed in picking or raising up the peritoneum have been entirely discarded.

### TECHNIQUE

The operation is performed as follows. Two ordinary square gauze pads or sponges are doubled or folded upon themselves. One is interposed between the fingers of the left hand of the surgeon and the skin of the patient on the left side and the other is interposed between the right hand of the assistant and the skin of the patient on the right side. In this manner the sterile gloved hands of the surgeon and his assistant at no time come in contact with the patient's skin. With the gauze pads in the position mentioned pressure is made downward and outward in order to render the skin tense. A free incision of desired

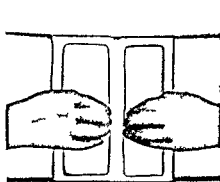


Fig 1

Fig 1 Shows left hand of surgeon and right hand of assistant in position with gauze pad interposed between hand and skin.

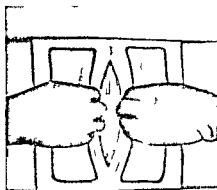


Fig 2

Fig 2 Skin superficial fascia fat and aponeurosis

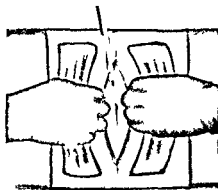


Fig 3

incision exposing muscle. Fingers of operator and assistant raise layers of abdominal wall.

Fig 3 Left rectus split in direction of fibers. Layers of abdominal wall elevated. Peritoneum being incised.

length is then made through the skin superficial fascia and fat down to the aponeurosis. The fingers of the surgeon and his assistants then slide over the margin of the incision having the gauze pads still interposed between the skin of the patient and the thumbs of the operator and his assistant. This preclude the possibility of the fingers coming in contact at any step of the operation with the skin of the patient. The skin and superficial fascia and fat are now grasped between the thumbs and the finger over the edge or margin of the incision and lifted upward. Free incision of the aponeurosis is made. The recti muscles may be separated in the median line or the right or left rectus may be split in the line of its

fibers according to the preference of the operator. When the separation of the muscle is accomplished the fingers of the surgeon and his assistant slip underneath the separated fibers and raise the layers of the abdominal wall. This at the same time lifts and makes tense the peritoneum which can now be readily incised without any danger of injuring the underlying structures.

This method of opening the abdominal cavity is performed in the shortest possible time because it eliminates the use of numerous instruments and gives very rapid access to the organs within. Furthermore we have used it now for more than three years and have had no instance of injury to any structure since its adoption.

## AN OPERATION FOR THE CURE OF INCONTINENCE OF URINE

B. HUGH HAMPTON YOUNG, M.D., F.A.C.S., BALTIMORE, MARYLAND

J. M. B. H. B. D. L. I. I. I.

IN 1908 I described a new operation for the cure of incontinence of urine (1) and reported one case which was operated on now ten years ago. The result in this case is so splendid and the operation so successful that I wish again to bring it to the attention of the surgical profession with further clinical reports. As pointed out in my original paper in 1908 there are a few scattered articles bearing on the cure of incontinence of urine to be found in the literature, but no successful procedure, particularly in the male, had ever been carried out or proposed. The method which I presented was and is so far as I have been able to discover quite original.

Since incontinence of urine comes from various causes a very careful preliminary study is necessary in order to determine exactly the situation present, particularly in regard to the internal and external sphincter, as well as the condition of the posterior urethra and bladder. In the study the ordinary cystoscope, the cystourethrocope and the tubular endoscope are all quite necessary and very careful neurological studies are desirable in order to rule out spinal cord lesions. In cases for which this operation is intended both the internal and external sphincters are found dilated or impaired and the operation is directed toward the plastic reformation of the injured sphincter and a restoration to normal tonic closure. The operation consists of two stages: first a suprapubic attack upon the internal sphincter and second

a perineal attack upon the external sphincter and triangular ligament.

### TECHNIQUE OF OPERATION

**Suprapubic Operation.** With the patient in the Trendelenburg position a generous incision is made in the median line so that an excellent exposure of the interior of the bladder is obtained. Examination shows the dilated internal prostatic orifice and in both of my cases there was evidence of division of the vesical sphincter posteriorly, that is a separation of the cut end covered with healed mucous membrane but leaving a widely dilated internal orifice (Fig. 1). The triangle was also found divided and separated almost completely into two halves.

The first step of the plastic operation consists of denuding the mucous membrane over the lateral and posterior aspects of the prostatic margin. This is done by means of a long toothed forceps and curved scissors and should extend into the posterior urethra and also include some of the vesical and trigonal mucous membrane so as to leave wide muscular surfaces for approximation (Fig. 1 & 2).

The suturing is the most difficult part of the procedure. It is necessary that the needle should penetrate deeply into the urethra in order to get firm approximation. With the ordinary needle holder such as I used in my first case the operation was accomplished but with difficulty. In the

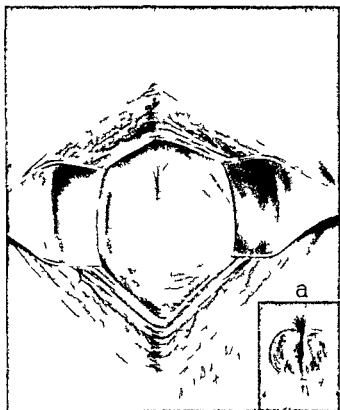


Fig 1 View of base of bladder showing dilated internal vesical sphincter. Insert 1 shows area denuded of mucous membrane preparatory to suturing

second case a new needle holder which I have called the boomerang (Figs 8 and 9) on account of its similarity of action has been employed very effectively. This instrument greatly facilitates the passing of stitches in deep narrow localities and is especially useful because it causes the needle to penetrate in the direction of the shaft of the needle holder rather than at right angles as in the case of most other instruments.

The first suture of medium sized chromic catgut is placed posteriorly and if the trigone has been divided includes a part of this as shown in Figures 3 and 4. Subsequent sutures are placed in the same way the operator being careful as remarked above to have the needle penetrate deeply and to draw together the urethral surfaces of the internal prostatic orifice. In using my boomerang needle holder as will be seen at once one first penetrates deeply with the needle (Fig 2) the point of which returns like a boomerang through the tissues toward the operator who then hooks the suture in the eye of the needle with the fingers (Fig 3) or with a special forceps. The operator then releases the pressure upon the handle the spring inside of which pushes the inner rod backward thus drawing the boomerang

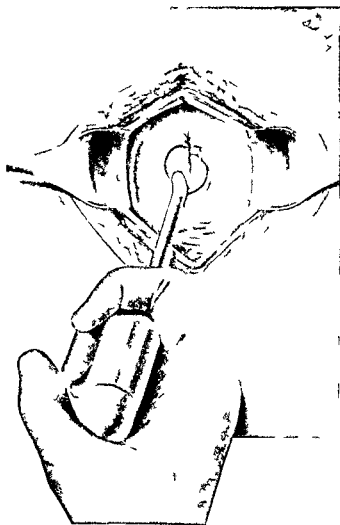
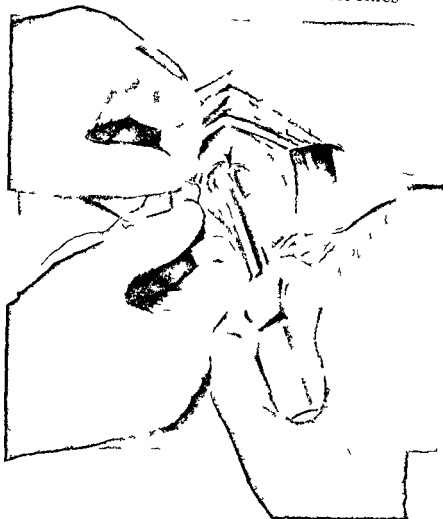


Fig 2 Use of boomerang needle holder shows point of needle about to be inserted into tissues

needle with the suture attached through its track where it is grasped and tied (Fig 4). Subsequent stitches are placed in the same way usually starting on the left side from within the urethra out to the bladder and finishing on the right side penetrating from the bladder into the urethra when the suture is picked up and drawn back through the track thus completing the act. Figure 5 shows finished suture line. Usually four or five sutures are desirable in order to procure a large mass of tissue posterior to the small catheter which has been placed in the urethra and which is allowed to remain for urinary drainage. Care should be taken not to draw the stitches too tightly. The catheter should be left in place if possible for about ten days.

The vesical wound is then closed anteriorly with a continuous mattress suture leaving a small space at the upper end for a medium sized drainage tube to emerge which is fastened to the bladder and also to the skin. The recti muscles and



The illustration shows the patient in the lithotomy position with the legs spread apart. The surgeon is performing a perineal incision. The drawing is a high-contrast, woodcut-style illustration showing the anatomical structures and the surgical incision.

kin are approximated with the thigh and through silver wire suture leaving room for a small preperineal gauze drain at the lower angle of the wound. Continuous drainage is applied by means of the Davis vacuum bottle on the return of the patient to the ward and uprapid drainage maintained for at least 48 hours (Fig. 6).

**Perineal operation.** The patient is now placed in the lithotomy position upon the Halsted perineal board the legs being well elevated so as to furnish an excellent exposure of the perineum. The incisions are made carefully excising as much as possible of the caruncle present in the perineum. Usually a long oval incision is made and carried down toward the triangular ligament on each side until the urethra is approached the presence of the rubber catheter rendering identification easy.

In the dissection in the region of the triangular ligament and vaginal puncture care must be taken not to excise too much tissue as an important blood vessel draws to either the muscular structure of this region. It is generally desirable to open the urethra and probably excise a small portion posteriorly as it is usually dilated. The ischiorectal tissue around the urethra should be excised as far as possible so as to obtain good muscle tissue for approximation and it may be necessary to make parallel incision one or two centimeters distant from the urethra in order to liberate external adhesion and free the tissues sufficiently for suturing care being taken that important nerve and blood vessels are avoided.

The closure of the urethra is then begun. As a rule continuous medium sized chromic catgut is



Fig. 4. Needle has been pulled back by released ring in handle of instrument drawing suture back through tissue.

used though occasionally interrupted sutures are preferable. After closing the urethra a second line of sutures is placed so as to include the more

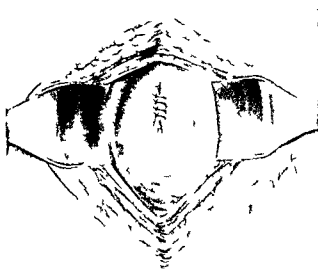


Fig. 5. Suture line after completion of plastic operation upon internal plate.

muscular structure and often a third line of sutures is advisable for reinforcement and further approximation. The skin and subcutaneous tissues may be closed completely or with partial drainage at the upper or lower angle of the wound. The external sutures are unimportant and in fact the skin may be left open for drainage. In some of the cases very little healthy muscle is found in



Fig. 6. D. J. McGuire, M.D., Director of the Department of Urology, University of California, Los Angeles. The building shown is the main building of the University of California, Los Angeles, which is the site of the Department of Urology.







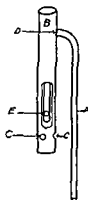


A SIMPLE METHOD OF DRAINING THE BLADDER AFTER  
SUPRAPUBIC PROSTATECTOMY

BY F. DENEGLE MARTIN, M.D., F.A.C.S., NEW ORLEANS

IN the December 1917 issue of SURGERY, GYNECOLOGY and OBSTETRICS Norman H. Bcal of London, Ontario, describes a method of draining the gall bladder after suprapubic operations. For years I used the identical apparatus which was presented at the Atlanta meeting of the Southern Surgical and Gynecological Association in 1900. A full description of it will be found in the transactions of that meeting. More recently I have used a much simpler method which works on the same principle but does away with the paraphernalia necessary for the priming. All that is necessary is a large catheter *E* and a piece of rubber tubing *B*  $\frac{1}{2}$  inch in diameter long enough to reach from the fundus of the bladder to a point one inch above the skin. Several small holes are cut in the tube near the end to be placed in the bladder *C* and one at the level of the skin *D* large enough to insert the catheter snugly so that the urine will not escape. The catheter is pulled through this opening to about  $\frac{1}{2}$  inch from the bottom of the large tube *E* the tube is introduced into the bladder and the wound closed tightly around it. As soon as the urine rises in the tube above the point

where the catheter is inserted *D* it will prime the catheter and empty the bladder. It is simple and most effective. This apparatus like other of its kind needs intelligent handling. In flush-



ing the bladder the fluid is sent through the catheter and flushes the large tube cleansing the bladder at the same time. This drain is used until the urine is free of blood clots and necrotic tissue. When removed a pezzet catheter is inserted and kept in the bladder as long as necessary.

## BOOK REVIEWS

[illegible]

very simple. The new volume appears closely bound but as one uses the book the binding loosens up and the book opens as easily as with the ordinary binding.

Every surgeon has been obliged to seek advice and consultants and how often has he been disappointed when he has been unable to obtain the help he so desired. This applies especially to the surgeon located in communities distant from the large medical centers the consultant in these cases being works supplied to give complete information on the subject in question. Monographs which are exhaustive and how few are exhaustive are the solution of the problem. The work of Frazer occupies a unique place in the surgical literature. The author states in the preface that it has been his purpose to deal with the subject so comprehensively that it will not be necessary for the reader to consult collateral works. He has meticulously accomplished his purpose. Every phase of the embryology, anatomy, physiology, pathophysiology, surgery of the spine and spinal cord has been presented in detail. In the field of surgery, a concise knowledge and information is not all that is necessary, but in that of disease and injuries of the spine and spinal cord. Many of the facts are so complete that they extend beyond the mental scope of man to retain them and a monograph which contains the full and accurate information surely values. Neurological cases are numerous so that the very serious manifestations and the changing characteristics. This is the realm of speculation, speculation with thought and imagination. The author obtained by close observation and the help derived from the experience of the master. The author by his endless efforts has endeavored for knowledge and his utter enthusiasm for the neurological surgery has placed before the

profession of the world a landmark in the surgical literature. There is no monograph before the profession today known to the reviewer which specifically treats a topic so thoroughly and with such striking accuracy. One might conscientiously prophesy that many years will elapse before it will be replaced or supplanted. J A W

**VOLUME II** of the system of urology edited by Cribot<sup>1</sup> referred to in a previous issue comes well up to the standard adopted in volume I. This volume is devoted to the bladder, the ureter and the kidney. It is pleasing to note that phenomena concerning the urinary act are discussed and some information ventured regarding the mechanism. The chapter devoted to functional tests of the kidney is excellently written and will afford a most valuable asset to any man even though he be a general practitioner, an internist or a general surgeon. No organ plays a more important role than the kidney and to have means at hand to determine its functional activity is surely valuable. The frequency of confusion in the diagnosis of acute or subacute abdominal conditions impresses one with the necessity of close observation to all organs lying within or adjacent to the peritoneal cavity. How often is an innocent appendix removed when the patient is suffering from urethral calculus or pyelitis. It behooves every medical man to avail himself of information which will enable him if possible to avoid such we might say gross errors. Every practitioner must know urology to a certain extent in order that he may call upon the urologist for that assistance which may mean the health or even life of the patient. The work can truly be called the urologist's text and the practitioner's professional aid. J A W

**THE** rapidly terminating great war has been a tremendous stimulus to the profession to advance the sciences of medicine. No sooner was the first campaign well under way than the surgeons of France, Belgium and England as well as those of the enemy were confronted with almost unsurmountable obstacles. Due to the multitude of injuries practically all infected many extensive and mutilating due to high explosives it was at once realized that much had to be done to cope with such a catastrophe. Immediately the surgeon put his shoulder to the wheel. The untiring effort of these undecorated heroes bore fruit. Many theories were put into practice, some were good, others did not come up to the expectations of the instigator. Soon there began to appear articles and papers giving the results in the various fields of study and experiences. All were intensely interesting as they told the story of gruesome destruction and of the conquering effort. It is an almost endless task to be able to obtain all the interesting document as many appeared only in the French, Belgian, Italian

and English journals and were never translated. This brings me to the little volume<sup>2</sup> which was intended for the medical officer to supply him with brief abstracts of the important war topics of the day. It consists of abstracts of articles dealing with war surgery taken from the French, English, Italian, Belgian and early German journals. Several articles are practically complete as they did not permit of much condensation.

The subject matter is divided into sections devoted to general topics, wound infection and treatment, tetanus, gas, gangrene, abdomen, chest, cardiovascular surgery, joints, fractures, burns, anesthesia in warfare, trench foot, foreign bodies, peripheral nerve injuries and jaws and face. It is the reviewer's impression that most of these abstracts are taken *in toto* from the **INTERNATIONAL ABSTRACT OF SURGERY** and consequently the readers of this journal have probably read the greater part of this volume. Owing to the necessity for the civil application of many of the procedures adopted in warfare every surgeon should acquaint himself with what has been done abroad and in no way can he so easily procure the ready information as in this little volume. J A W

**THE** volume<sup>3</sup> represents the highest development of the monographic type of bookmaking. The time is rapidly arriving if it has not already arrived when even the general worker in medicine and surgery will be obliged to rely more strongly on special monographs than on general textbooks. Of the monographs already published none merit a more definitely fixed position in the library of the student and practitioner than the special volumes that Cushing has gotten out.

A very brief abstract outlining the material considered in this work will be found in the **INTERNATIONAL ABSTRACT OF SURGERY** this month, p. 39. C B

**SUSPENSION** in the Treatment of Fractures by P. Desfosse and Charles Robert is one of the **Horizon** Series of monographs devoted to war medicine and surgery published by Masson et Cie during the present year. A preface by Pierre Duval, surgical consultant in the French medical service, adds weight to the undoubted excellence of the monograph.

There had been up to the time of its publication no complete description in French of the method of continuous suspension and extension in the treatment of fractures accompanying war injuries, but Robert had made use of this method for a year in the service of *l'inf. chir.* (surgical ambulance).



# AMERICAN COLLEGE OF SURGEONS

## DOCKET OF THE REGENTS AND OTHER NOTES

### PROPOSAL FOR MEMBERSHIP IN COLLEGE

WITH world peace in sight and the probable early return of about one third of the Fellows of the College from military service to private practice the Regents of the College have prepared a docket in order to consider lines of progress for the College during the coming year. This docket which will be acted upon at an early date is of interest to the entire medical profession. Two characteristics of it stand out. First every proposal in it carries a direct aim to better the practical life of Canada and the United States as well as to advance the scientific economic and ethical standards of the profession. Second a whole some readiness evidently exists on the part of the College to co operate with other medical organizations and agencies which make for similar aims. Probably the most important proposal in the docket is one looking to membership in the College. The fact that the College has on file about 9,000 applications for Fellowship undoubtedly has a bearing in this matter. The object of the provision for membership is briefly stated as follows:

First the encouragement of more thorough training in surgery and of higher standards of practice among younger men most of whom will eventually become Fellows of the College. Second extension of the direct influence of College to surgeon in the making—at a time when most of these men are not eligible to Fellowship and at a time when they will derive the greatest benefit from the influence of the College. Third advisability of advancing the standard of efficiency for admission to Fellowship in the College without lessening its influence by a resultant tendency toward exclusiveness.

In this connection these figures are pertinent. Population in England and Wales 40,000,000. Number of doctors 35,000. Fellows in Royal College of Surgeons 1,581. Members in Royal College of Surgeons 16,040. Population in Canada and United States 110,000,000. Number of doctors 159,444. Fellows in American College

of Surgeons 3,941. Members in American College of Surgeons none.

Chief points suggested in consideration of the provision for members are graduation from a creditable medical school and service as an interne for at least one year. Moral and ethical fitness is required for admission to Fellowship. Same to be approved by the respective provincial and state credentials committees. Approval of candidates for admission to Fellowship by examination to entitle candidates to membership in the College.

### HOSPITAL SERVICE BUREAU

The work of the College during the past year among hospitals and the hearty co operation of the hospitals in this work bring now the forcible proposal that the College establish a hospital service bureau. The object of this bureau is to give assistance to individual hospitals upon request covering the sum of things which make for hospital efficiency. For example the service of the bureau would co operate with hospitals upon such subjects as right standards of training, faithfulness to duty and character requisite for the privilege of practice in hospitals, plans for new hospitals, reconstructions and additions, equipment and upkeep of hospitals, organization of the hospital board and of the staff, study of sources of hospital income, adjustment of hospital service to need in community, cost accounting, and business methods, adaptation of case records and of laboratories to needs of hospital, encouragement of research and of helpful analyses of clinical work in the hospital.

### HONORARY FELLOWSHIPS CONFERRED IN NEW YORK

BECAUSE of the prevalence of influenza throughout Canada and the United States it was considered by the Regents imperative on October 12 to cancel all of the meetings of the College scheduled to be held in New York for the week beginning October 21. These meetings included the Clinical Congress, the Convocation and the hospital conference.



In the meantime the surgeons from England France and Italy who accepted invitations of the College to take part in the Clinical Congress week had sailed for New York. They arrived in New York on October 19. These surgeons were:

Sir Thomas Miles C.B. Dublin Honorary Surgeon to His Majesty King George Conulting Surgeon Irish Command Member Board of Conultant British War Office and Senior Surgeon Richmond Hospital Dublin

Lieutenant Colonel Raffaele Bastianelli Italian Army Medical Corp Home Surgeon in Chief First Division Hospital Policlinico Umberto I Aacute Professor of Clinical Surgery Royal University

Major Pierre Duval French Army Medical Corp Conulting Surgeon to Seventh Army Honorary Professor Faculty of Medicine Paris

Colonel George Ernest Calk D.S.O. London Conulting Surgeon British Expeditionary Force Joint Lecturer in Surgery St Bartholomew's Hospital University of London Surgeon in Charge Out Patient St Bartholomew's Hospital

Major George Grey Turner Royal Army Medical Corp Newcastle on Tyne England Honorary Assistant Surgeon Naval Infirmary New Castle on Tyne Lecturer in Surgery University of Durham

Major Alfred P. P. P. Pollet French Army Medical Corp

Major Henry Buckle French Army Medical Corp

Lieutenant Colonel George I. Brewer of New York at the time in service in France came with the delegate of the College as the official representative of the medical corps with the American Expeditionary Forces

In order that the value of the meetings which these visitors brought from the allied line at the front might not be lost as a result of the cancelled meetings the College arranged promptly to have the eleven visit as many of the surgical centers in this country as their brief stay would permit. These visits included Washington where the visitors were greeted by President Woodrow Wilson at Camp Greenleaf Georgia Minneapolis Pocheater Chicago Pittsburgh Philadelphia and New York.

On the evening of November 6 at a dinner arranged by the Fellow of New York City through Dr J. Bentley Squier honorary fellow

ships were conferred upon Surgeon General Merritt W. Ireland United States Army Sir Thomas Miles C.B. Lieutenant Colonel Raffaele Bastianelli Major Pierre Duval Colonel George Ernest Calk D.S.O. and Major George Grey Turner. The honorary fellowship were conferred by Colonel William J. Mayo President of the College. Dr George David Stewart was toast master of the occasion.

## CANADIAN FELLOWS EXPRESS THEIR OPINION

THE surgeons of the combined surgical section of the Ontario Medical Association and of the Canadian Medical Association which met at Hamilton Ontario in September took action of vital significance to the medical profession and to the welfare of life in Canada. The section was stated passed unanimously the following resolutions:

Be it resolved that we the Surgical Section of the combined meeting of the Ontario Medical Association and the Canadian Medical Association be it be on record approving the effort being made by the American College of Surgeons to improve the status of surgical practice in our hospital that the right to attempt major surgery should be restricted to those who are recognized as having scientific training experience sound judgment and honesty of purpose

that examinations for diagnosis and for treatment should be much more closely associated with clinical laboratories than they are at present

Be it resolved That copies of the above resolution be sent to the American College of Surgeons to the Commissioner dealing with the medical matters in the Province of Ontario to the universities teaching medicine in Canada and to the Dominion Medical Council and the licensing bodies in Canada

## MILITARY SERVICE OF CANADIAN FELLOWS

THE directory of the College for 1918-1919 will designate the military service of the Fellows. In this connection an inspiring fact comes from Canada. Of the 1,766 Canadian Fellows 1,260 or 71.6 per cent of them have within the past four years been in the military service of their government.

# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE PUBLISHED MONTHLY

VOLUME XXVIII

FEBRUARY 1919

NUMBER 2

## THE CLINICAL SIGNIFICANCE OF CONGENITAL ANOMALIES OF THE KIDNEY AND URETER

WITH NOTES ON THE EMBRYOLOGY AND FETAL DEVELOPMENT OF THE KIDNEY

By H. G. BUGBEE, M.D., F.A.C.S., NEW YORK

U. S. G. S. S. L. K. W. M. d. L. J. I. Hosp. I.

AND

J. R. LOSEE, M.D., NEW YORK

P. H. G. S. S. L. K. W. M. d. L. J. I. Hosp. I.

A COMPREHENSIVE knowledge of the embryology of a given species human or otherwise is necessary before one can arrive at definite conclusions concerning the cause of anomalies of development in individuals of the particular species. In this paper therefore we shall endeavor first to give a brief outline of the development of the organs of the upper urinary tract in the human and then to trace the relationship between this and the various anomalies which have been noted.

A bibliography together with a brief summary of some of the published observations is appended.

In the development of the kidney we are concerned with the growth of three definite and distinct organs which are formed at different stages in the growth of the embryo. These organs are known as the pronephros, the mesonephros and the metanephros. The first two degenerate while the third remains as the permanent kidney. It so happens that the second begins to develop while the first degenerates and the third begins to develop as the second degenerates so that both a constructive and a destructive process is going on at the same time.

The pronephros carries on an excretory function during its existence but there is some discussion as to whether the mesonephros exercises a similar function. Some observers believe that it has not such a function but that it may be active in some other way. It is known however that it does form the beginning of the metanephros and of the reproductive apparatus. The metanephros goes on to complete development and is the active excretory organ at birth.

### PRONEPHROS

The first anlage of the pronephros consists in the pronephric tubules. Each primitive segment stalk throughout the body cavity produces a pronephric tubule which is composed of a principal tubule, a pronephric chamber, nephrostome canal and an internal and external glomerulus. By the union of these pronephric tubules a collecting duct or an excretory duct is formed running the entire length of the body cavity. The development of the pronephric tubules is divided into two portions: first the development of the pronephric tubules and the collecting duct; second the development of the terminal portion of the primary excretory canal.

The first anlage of the glandular portion occurs in an embryo 1.3 millimeters in greatest length. The development goes on so quickly that when the caudal portion is developed in an embryo of 2.5 millimeters the cranial sac is beginning to dissolve so that as the lower portion develops the upper portion degenerates. In an embryo of 4.5 millimeter vertex breadth length the degeneration of the pronephros is well advanced but the time of its complete disappearance cannot be definitely stated since it extends into the territory of the mesonephros. The take place approximately when the embryo is 4.9 millimeter in its vertex breadth length.

The blood supply of the pronephros is derived from a ventral arch system which is divided into two groups: a cranial group of aortic arches and a caudal group of originally pronephric arteries.

#### MESONEPHROS

The metanephric tubules develop from the same parent tissue as the pronephros, that is the stalk of the primitive segment and they make use of the same efferent canal, the primary excretory duct. The principal tubule of the metanephros, however, usually arises more medially than those of the pronephros.

The metanephric anlage begins to develop from the nephrogenic cord which arises from the primitive segment stalks cut out as a whole from the mesoderm in an embryo of 2.5 millimeter greatest length. Light metanephric vessels form anteriorly and posteriorly. As the embryo increases in length the oldest tubules gradually take on various changes in shape until at 9.5 millimeters greatest length they are complete. In an embryo of this length there are 32 to 34 tubules consisting of malpighian corpuscle and a secretory and a collecting tubule. In an embryo 19.4 millimeters vertex breadth length they separate from one another and as a result of the curvature of the excretory duct become stronger in order to reach the usually placed bladder. The malpighian corpuscles are pressed together and the collecting duct of one tubule may serve as the efferent for several. As a further result of the bending

of the excretory duct the orifices of several collecting ducts unite to form a single one.

The degeneration of the mesonephros occurs in two periods. The first begins as soon as the growth cranially is complete that is in an embryo 5.3 millimeters in length and is finished in an embryo of 21 millimeters greatest length. During the process the greatest part of the mesonephros at the cranial end is degenerated. The second period comes on so gradually that definite time limits are not possible for it. Within this period there occurs a new suppression of tubules and a selection of those that will enter the crux of the reproductive system and of those that will persist even in the adult human organism as the *paragentialis*. In animal without a metanephros this latter or lower portion becomes the actual functioning kidney. Eliminated by tubules 57 are degenerated out of a maximum of 83 that develop. The corresponding portion of the excretory duct disappears along with the tubule. From the time of 1 millimeter greatest length onward all embryos show a rather constant number of metanephric tubules in the lumbar segment but these are almost all broken in one or several places. The first metanephric arteries are formed in an embryo of about 5.3 millimeters in length. They arise from the lateral surface of the aorta proximal to the malpighian corpuscles and terminate in the crux with an enlargement assuming a spherical shape. The arteries are not paired. In the cranial segment one artery may lie in each segment or in two or three segments but in the caudal segment the arteries become more numerous. From the sixteenth thoracic to the third lumbar all the metanephric arteries persist and from these are formed the phrenic, suprarenal, accessory renal, internal spermatic, accessory spermatic and also the branches to the lymph nodes and sympathetic ganglia in the region between the superior and inferior mesenteric arteries.

#### METANEPHIROS

The metanephros may be divided embryologically into two portions, the secretory or glandular portion and the efferent apparatus.

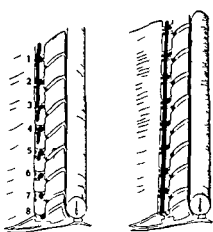


Fig. 1

Fig. Diagram of the development of the pronephros. The principal tubule (3, 6, 7 and 8) develop by evagination from the parietal mesoderm of the primitive segment stalk. They grow caudally (3 and 4) and reach and overlap the succeeding tubules passing laterally to them (2). The principal tubules which are thus brought into apposition fuse and a collecting duct (2) is formed. The collecting duct remains in connection with the various segment stalks by means of the principal tubules (from Keibel and Mall *Human Embryology*).

Fig. Model of the mesonephros of the metanephros and the bladder of a human embryo of 7 millimeters greatest length. The mesonephros lies in a perpendicular position and the individual tubules are at sufficient distances so that the malpighian corpuscles lie in a single row. The lowest tubules are still developing, but have already united with the excretory duct. The fully developed

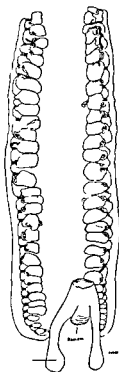


Fig. 2

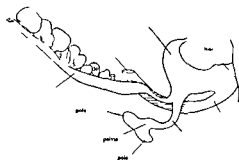


Fig. 3

of the canal are S shaped. Most ventrally are the malpighian corpuscle. In the middle is the secretory tubule and most dorsally is the collecting tubule. The loop formed by the secretory and collecting tubules usually has not yet reached the medial border of Bowman's capsule. The whole coil of a mesonephric segment (malpighian corpuscle and the two tubules) lies still in one horizontal plane (from Keibel and Mall *Human Embryology*).

Fig. 3. Model of the bladder, primary excretory duct and ureter of an embryo of 9.5 millimeter greatest length.

The common position by which the primary excretory duct and the ureter open into the bladder is enlarged and is more sharply differentiated from the wall of the bladder. The ureter has differentiated into the primitive renal pelvis and the ureteric segment stalk. The two pole tubules are beginning to grow out from the primitive pelvis (from Keibel and Mall *Human Embryology*).

tus. We will first consider the latter, namely the ureter, the renal pelvis and the collecting tubule system, all of which develop from the primary excretory duct.

The anlage of the ureter arises as a hemispherical outgrowth of the primary excretory duct in an embryo sometimes between the stages of 4.5 millimeters and 5.3 millimeters total length. The short ureter grows at first dorsally toward the vertebral column but later in an embryo of 8.5 millimeters and 9.5 millimeters greatest length it forms a curve which becomes gradually flatter and the ureter grows cranially. When it gains the dorsal surface of the mesonephros it lies in the retroperitoneum surrounded by loose mesenchyme. Here radial outgrowths of the collecting tubules take place and the definite position of the renal pelvis is reached in an embryo 9.5 millimeter to 13 millimeters greatest length at the level of the second

lumbar vertebra. While the ureter is still in the period of outgrowth the primitive pelvis elongates in the craniocaudal direction and thus requires its poles both of which grow out in opposite directions and so begin the formation of the collecting tubules of the first order. Later horizontal tubules develop corresponding to the middle of the renal pelvis, one directed ventrally and the other dorsally. These four primitive tubules become enlarged at the blind ends to the so called ampullae. From the various angles of the ampullae secondary collecting tubules grow out parallel to the future surface of the kidney. When they attain a certain length they develop ampullae from the various sides of which tertiary tubules are formed and so the process goes on up to the formation of the terminal collecting tubules. The formation of new collecting tubules ceases at the fifth month. The entire ureteric tree spreads



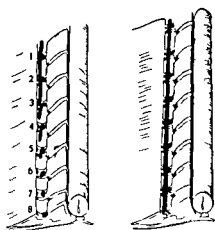


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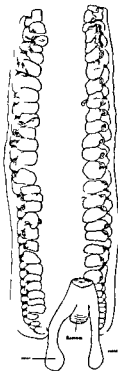


Fig. 2

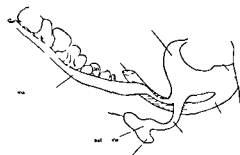


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Fig. 2 Model of the mesonephros. The metanephros and the bladder of a human embryo of 5 millimeters greatest length. The mesonephros has a perpendicular position and the individual tubules are at different distances so that the malpighian tubules lie in a single row. The lowest tubules are still developing but have already united with the excretory duct. The fully developed

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tus. We will first consider the latter, namely the ureter, the renal pelvis, and the collecting tubule system, all of which develop from the primary excretory duct.

The anlage of the ureter arises as a hemispherical outgrowth of the primary excretory duct in an embryo sometimes between the stages of 4.5 millimeters and 5.3 millimeters total length. The short ureter grows at first dorsally toward the vertebral column but later in an embryo of 8.5 millimeters and 9.5 millimeters greatest length it forms a curve which becomes gradually flatter and the ureter grows cranially. When it gains the dorsal surface of the mesonephros it lies in the retroperitoneum surrounded by loose mesenchyme. Here radial outgrowths of the collecting tubules take place and the definite position of the renal pelvis is reached in an embryo 9.5 millimeter to 13 millimeters greatest length at the level of the second

lumbar vertebra. While the ureter is still in the period of outgrowth the primitive pelvis elongates in the cranio-caudal direction and thus acquires its poles both of which grow out in opposite directions and so begin the formation of the collecting tubules of the first order. Later horizontal tubules develop corresponding to the middle of the renal pelvis, one directed ventrally and the other dorsally. These four primitive tubules become enlarged at the blind ends to the so-called ampullae. From the various angles of the ampullae secondary collecting tubules grow out parallel to the future surface of the kidney. When they attain a certain length they develop ampullae from the various sides of which tertiary tubules are formed and so the process goes on up to the formation of the terminal collecting tubules. The formation of new collecting tubules ceases at the fifth month. The entire ureteric tree spreads





Fig. 5. Horse kidney. This specimen was obtained from a stillborn female infant at eight months. The lower pole is united by a ridge of tissue with the upper pole. It does not over the rim of the pelvis and lies opposite the bifurcation of the aorta. The pelvis is not continuous. There are two ureters from the right kidney, one from the upper portion and the other from the lower portion and part of the body. These pass over the anterior surface of the kidney and run a parallel course to unite in the middle of the bladder. There is a common orifice in the triangle from the left kidney, the assessor ureter. It passes over the anterior surface of the kidney and takes its normal course to the bladder.



Fig. 6. Stillborn kidney. This specimen was obtained from a stillborn female infant near term. The mass of kidney tissue made up of both the left and right kidneys lies on the left side. The upper pole is opposite the first lumbar vertebra and the lower pole is in the true pelvis. The pelvis is not continuous. The pelvis of the upper kidney is normally placed and the ureter takes a normal course downward and enters the left side of the bladder. The pelvis of the lower kidney is anterior. The kidney did not rotate. The ureter lies on its anterior surface and enters the right side of the bladder. The triangle is normal. It will be noticed that both suprarenals are in their normal position.

which the afferent and efferent blood vessels pass and egress. The vascular and urinary poles of the malpighian corpuscles lie opposite to each other.

The development of the cortex begins with the formation of the first generation of the uriniferous tubules and its increase in thickness depends in the first place upon the new formation of additional tubules and in the second place on the growth of those already present.

The medulla begins to form after the formation of the definitive renal pelvis. Its increase in length and thickness is due to an increase in the diameter of the individual collecting tubules. During fetal life it is the medulla that grows principally. After birth a cessa-

tion of the growth of the medulla occurs and continues until the seventh year during which period the diameter of the cortex increases rapidly. After the seventh year both the cortex and the medulla develop equally.

#### CAPSULE

Embryonic connective tissue surrounds the growing ureter, the outgrowing tubules and the metanephrogenic tissue from the beginning. But this is not considered a capsule until it can be separated from its adjacent structures which is at first distinctly seen in an embryo of 30 millimeters greatest length.



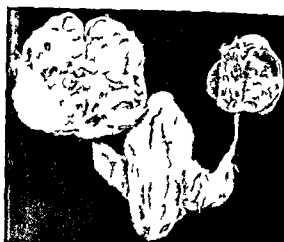


Fig. 9. The specimen obtained from the embryo of the first trimester of pregnancy. The kidney is shown in its normal position, with the renal pelvis and calyces visible. The renal vessels (artery and vein) are also shown.

life the craniocaudal diameter of the kidney correspond approximately to the first three lumbar vertebra. In the second half the cranial pole lie at the level of the eleventh rib and the caudal one descends to the upper border of the fifth lumbar vertebra.

#### RENAL ARTERIES

The renal arteries are not new formations each being formed from a mesonephric artery. The kidney climbs upward to the mesonephric artery and as soon as sufficient blood supply is assured the caudal branches separate from it. When the kidney has acquired its definite position it possesses several renal arteries one of which become greatly enlarged to form a definite artery while the others degenerate or persist as accessory renals. The definite renal artery is either the last vessel of the second group or the first of the third group of mesonephric arteries. In an embryo of 6 millimeters greatest length the arrangement of the arterial apparatus is acquired.

#### ABNORMALITIES OF THE KIDNEY CONSIDERED AS TO THEIR NUMBER, FORM AND POSITION

There may be complete absence of one or both kidneys. In such a case the Anlage of one or both failed to bud off from the excre-

At 7 millimeters in length the renal bud lies opposite the second sacral vertebra and its pelvis looks anteriorly. At 10 millimeters the upper border of the kidney is at the brim of the pelvis and at 14 millimeters the upper pole is at the third lumbar vertebra. At 16 millimeters the kidney has passed the second lumbar line and has rotated 90° on its long axis so that the pelvis is lateral to the ureter and points toward the vertebral column. At 20 millimeters the ureter and kidney are in their relatively normal position. Felix says that during the first half of fetal

#### CHANGE IN THE POSITION OF THE KIDNEY

At 7 millimeters in length the renal bud lies opposite the second sacral vertebra and its pelvis looks anteriorly. At 10 millimeters the upper border of the kidney is at the brim of the pelvis and at 14 millimeters the upper pole is at the third lumbar vertebra. At 16 millimeters the kidney has passed the second lumbar line and has rotated 90° on its long axis so that the pelvis is lateral to the ureter and points toward the vertebral column. At 20 millimeters the ureter and kidney are in their relatively normal position. Felix says that during the first half of fetal

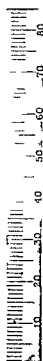


Fig. 9 Torsion of the ureters. This specimen was obtained from an infant which lived eight days. It was suddenly seized with convulsions and died four hours later. At autopsy both kidneys showed a moderate degree of hydronephrosis. The right ureter 1/2 centimeters from the kidney became dilated to four times its normal size for a distance of 4 centimeters at which point it appeared to be twisted on itself. After turning one half of a revolution a probe was easily passed through to the bladder. The left ureter was normal and presented no evidence of torsion. 2 centimeters from the bladder A silk worm gut suture shows the point of torsion.

Fig. 10 Incomplete double ureter

tioned that in an embryo of 7 millimeters both kidneys lie opposite the second sacral vertebra. Both may be placed at the same level having the same relative position or one may be ventral to the other. They may be placed one above the other and the upper pole of one may fuse with the lower pole of the other. If they lie at the same height and at the same relative position they may fuse at the lower poles or upper poles or centrally. Fusion at the upper poles is much less common than fusion at the lower poles. It probably occurs before the organ has grown out of the true pelvis. The earlier the date of fusion the more definite is the line of demarcation. In cases of very late fusion when the kidney has obtained its normal position the union may be limited to the capsule.

In fusion at the lower pole which is more common because they are nearer to each other than any other part of the kidney there is always a well marked bridge of kidney parenchyma joining them. The pelvis and ureters lie ventral to the bridge. If the ureters lie behind the bridge the fusion is a later one. The pelvis do not fuse because they are already well developed and independent structures before the parenchyma fuses. When central fusion takes place the organ

tory duct or if the anlage were formed it was either arrested or absorbed in the early course of its development. Absence of the ureter and maldevelopment of the reproductive organs result.

Supernumerary kidneys have occurred on one or both sides. If the renal bud sprouts early or if the division takes place at different points each division may simulate a mass of mesenchyme in which case there would be a double secondary anlage for the kidney. Theseanlagen are usually placed one above the other. They either remain distinctly separate throughout the period of their growth forming two kidneys on one or both sides or they fuse at some time during the course of development forming one kidney on each side. Both sides may fuse forming a large mass of kidney tissue.

Changes in form involving both kidneys result in what is generally known as the horseshoe kidney. It has already been men-

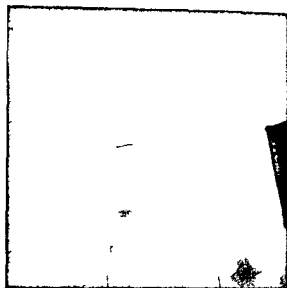
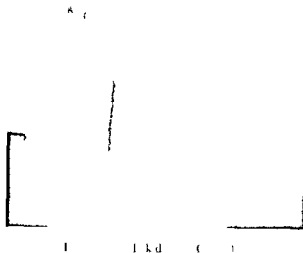


FIG. 1. Ectopic kidney (C. 4)

lie in the middle line and the ureter emerge ventrally. This type is known as the disc kidney. These kidneys may have two ureters each having a normal course and presenting a normal trigone or there may be multiple incomplete ureters.

End to end fusion of the two kidneys is quite uncommon. When it occurs both kidneys are placed on one side generally the lower kidney is not rotated and the ureter emerges from its anterior surface. The early stage of fusion is the outline of the organs can be distinguished easily one from the other. This type is known as the sigmoid kidney.

Fetal lobulations are sometimes observed in the adult kidney. This form is due to the fact that the growth of the cortex during postnatal life did not take place vigorously enough to obliterate the depression in the surface and also that the cortical columns were of such depth that the usual postnatal growth was insufficient to fill the grooves.

One of the most common forms of abnormal position of the kidney is known as ectopic or pelvic kidney. These kidneys may be found in the pelvis or in the site

pelvis. The fact is that they have failed to migrate during the early embryological period of the first eight weeks or their migration has been terminated at some time during the ascent. Many of these kidneys likewise do not rotate and their pelvis remain anterior. Ectopic kidneys remain arrested either just above the sacral promontory or in front of the lower lumbar vertebrae. A congenitally pelvic kidney can be differentiated from the acquired one by the length of the ureter and the relation of the vessel. Stephan (5) suggested that the causative factor of ectopic kidney was probably mechanical deviation from the normal development such as fetal colic.

#### THE PELVIS OF THE KIDNEY ITS FORM AND POSITION

Insufficient rotation or a failure to rotate leaves the renal pelvis in a medial or anterior position. As a rule however the pelvis enters the hilum in the middle third of the kidney or just below it. In the case of a very small kidney the pelvis may run along the length of the organ. The pelvis may be a kidney very near the lower usually a single pelvis at the primary tract at the posterior end and it may be intrarenal or



Fig. 13 Double ureter and complete duplication of renal pelvis on right side. Sharp angulation of left ureter and incomplete duplication of renal pelvis. (Case 6)

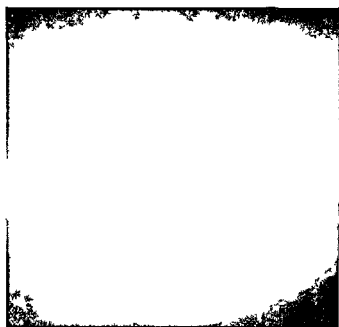


Fig. 14 Incomplete duplication of left renal pelvis (Case 7)

extrarenal. The ureter may divide into two or more branches before entering the hilum. The branching may be due to the same causes as a double ureter, that is, a double evagination of the excretory duct, or a deep ingrowth of one of the several transverse cortical columns during fetal development, by means of which process the pelvic division becomes dislodged downward and appears at the hilum. This wedge of kidney tissue divides the ureteral branches into two main bundles and the pelvis into two main branches. If there are two or more of these wedges the ureteral branches may be divided into three or more portions. According to Kelly and Burnam a divided pelvis occurs in about 8 per cent of cases examined.

#### CHANGE IN THE URETER

Change in the form of the ureter may be coexistent with change in the form of the kidney, or it may be found with normal kidneys. Abnormalities of the ureters are dependent on the renal bud, while anomalies of the kidneys result from abnormal develop-

ment of the mesenchyme. According to Pohlman (63) the abnormalities of the ureters may be divided into two classes: the incomplete double ureter and the complete double ureter. In the former the ureter has a common opening in the bladder, and in the latter each ureter has its own separate opening. Incomplete double ureter may be due to evagination of the excretory duct. If the renal bud divides too early, or if the division extends into the ureter segment, the splitting formed in the ureter itself would remain a permanent one, and any variation might exist from exaggeration of the upper and lower pelvis to an incomplete reduplication. In this type of ureter the pelvises are always distinct. The ventral ureter arises from the upper pelvis, and there is one orifice normally placed.

If the splitting of the renal bud is so complete that it is affected by the shortening of the segment of the Wolffian duct lying between it and the cloaca, it is possible for each division to acquire a distinct orifice in the duct, resulting in a double ureter. In complete double ureter the ureter from the upper pelvis has the lower orifice in the bladder, lying somewhere between the higher opening of the dorsal ureter and the opening in the genital duct.



# CONGENITAL HYDRONEPHROSIS

When congenital hydronephrosis is bilateral in imperforate urethra, the most common cause. In unilateral hydronephrosis, stricture of the ureter at its junction with the pelvis is the most common cause. Complete absence of the ureter and valve of the mucous membrane near the pelvis has also been observed in the female. The high insertion of the ureter into the pelvis of the kidney or its oblique insertion have been thought by some to be sufficient reason for obstruction. Anything producing intra-uterine pressure on the ureter or bladder thus preventing the discharge of urine into the sac of the amnion may be considered a cause of obstruction. Super-numerary vessels in close relation to the ureter at its origin have been observed in this condition.

From the foregoing it is apparent in the development of urinary apparatus, anomalies of number, size, position of kidneys or ureter, or review of the embryological development of the specimens tabulated should lead one con-

sider how easily the complexity in anomalous position of a brief exhibit new in

mind these possibilities and to investigate thoroughly all cases showing the slightest variation from the normal.

We are not yet in a position to say how often anomalies are found. The following twenty-three cases from a series of some ten thousand and urological examinations made by one of the writers (Bugbee) during the last ten years probably represent but a small proportion of the anomalies present in this series. An inspection of the bladder will demonstrate only the number of ureteral orifices present unless one or more be hidden by pathological changes. Shadow catheterization of the ureters can demonstrate anomalies of the ureters. It will be necessary to make a special study of this anomaly. Such examinations are necessary for

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FIG. 17. Incomplete duplication of both renal pelvis (Case 10)



FIG. 18. Incomplete duplication of right renal pelvis (Case 11)

#### ANOMALIES OF NUMBER OF KIDNEY

**CASE 1** *Single kidney* A woman Italian aged 20 married was seen in consultation December 15 1915. The patient complained of pain of a gnawing character in the right lower quadrant of the abdomen. The pain had begun in September 1915 and was relieved by a supporting corset. She had been free from pain until December when it returned became worse and was accompanied by chill and fever diminution of urinary output and obstinate constipation. A tender mass was palpable in the right upper abdomen. Cystoscopic examination revealed a well marked cystitis. The right ureteral orifice was slightly dilated and the area about it was somewhat more congested than the remainder of the bladder wall. A catheter passed 30 centimeters. The flow of urine was rapid cloudy contained pus blood cells and colon bacilli. The function was but slightly diminished. No left ureteral orifice was found although the trigone was easily distinguished. The right ureter was completely plugged with a large Garceau catheter and yet no urine entered the bladder during a period of three quarters of an hour. A pyelogram showed a large right kidney pelvis with dilated calyces. There was no kidney shadow on the left side. The catheter was retained in the right kidney pelvis for three days with daily lavage. The urine cleared the kidney decreased in size and the symptoms disappeared. The cystoscopic examination was twice repeated and the findings as regards the absence of a left kidney were the same. Indigocarmine was discharged from the right ureteral orifice in normal time but none was discharged from any other point in the bladder wall. No mass could be palpated in the kidney region on the left side.

**CASE 2** *Single kidney calculus obstruction of ureter* A woman Jewish aged 33 married was seen August 2 1917. She gave the history that one sister born with one arm died shortly after

then again how often are anomalies present without giving rise to symptoms?

Of practical importance is the fact that such anomalies do exist and that organs the seat of such anomalies are apparently prone to pathological lesions. In studying lesions of the kidney and ureter the complete knowledge of the presence and extent of an anomaly is of great importance not only in outlining and carrying out treatment for its relief but also as a guide to any surgical interference and operative procedure upon the kidney.

The following rule seems justifiable. If after a careful cystoscopic examination ureteral catheterization study of the separate urines and functional value of each kidney together with a roentgenogram with shadow catheters in position there exists in the mind of the experienced urologist a question as to the exact lesion present a pyelogram single or bilateral should be made. Many anomalies will never be diagnosed but when the anomaly is associated with a pathological lesion it will probably be detected.

The following cases are briefly tabulated

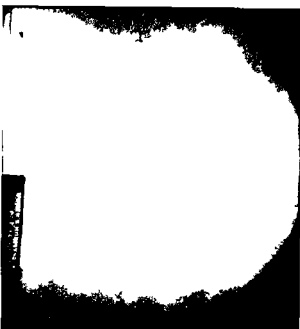


FIG. 5. Implant of the right kidney.

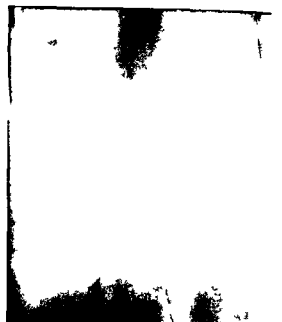


FIG. 6. Implant of the left kidney.

#### CONGENITAL HYDRONEPHROSIS

When congenital hydronephrosis is bilateral an imperforate urethra is the most common cause. In unilateral hydronephrosis stricture of the ureter at its junction with the pelvis is the most common cause. Complete absence of the ureter and valve of the mucous membrane near the pelvis has also been observed in these cases. The high insertion of the ureter into the pelvis of the kidney or its oblique insertion have been thought by some to be sufficient reason for obstruction. Anything producing intra uterine pressure on the ureter or bladder thus preventing the discharge of urine into the site of the amnion may be considered a cause of obstruction. Super-numerary vessels in close relation to the ureter at its origin have been observed in this condition.

From the foregoing it can be seen how easily an arrest in the development of the complicated urinary apparatus may result in anomalies of number, size, form and position of kidneys or ureters or both. Such a brief review of the embryology with the exhibition of the specimen taken from the newborn should lead one continually to bear in

mind the possibilities and to investigate thoroughly all cases showing the slightest variation from the normal.

We are not yet in a position to say how often anomalies are found. The following twenty-three cases from a series of some ten thousand urological examination made by one of the writers (Bugbee) during the last ten years probably represent but a small proportion of the anomalies present in this series. An inspection of the bladder will demonstrate only the number of ureteral orifices present unless one or more be hidden by pathological lesions. Shadow catheters in the ureter may demonstrate anomalies in number and position of the ureters but a pyeloureterogram will be necessary to demonstrate a renal or pelvic anomaly and often a ureteral anomaly. Such examinations have been a common practice for only a few years.

Just how far we are justified in going in making kidney and ureteral injection has always been a question. Only by making a routine pyelogram on all urological cases could we begin to ascertain the frequency of anomalies of the upper urinary tract. And

reported. This kidney as in the last case presented two ureters and two sets of vessels. The kidney was divided and each half placed as high in the abdomen as possible. A subsequent reontogram in 1913 with catheters in position showed each kidney well above the pelvis on each side, the bladder normal and urine from each kidney negative.

#### ANOMALIES OF KIDNEY PELVIS

**CASE 6** *Duplication of kidney pelvis (bilateral)*. The patient a man American aged 60 was seen February 10 1916. Following an attack of grippe seven weeks before he noticed blood in the urine developed frequency and burning urination which symptoms persisted. On examination a large irregular tender mass was palpable in the right side of the abdomen. This mass could not be palpated in the lumbar region. Cystoscopic examination revealed a slight congestion of the entire vesical mucous membrane. A catheter entered each of the ureteral orifices which were in normal position and passed 25 centimeters on the right side and 28 centimeters on the left side. The urine from each side was hazy with pus and both showed colon bacilli on culture. The function on the right side was two thirds that of the left. The phthalein output from both kidneys was 51 per cent for two hours. A double pyelo ureterogram was made which showed on the right side double ureter above the pelvic brim and a complete duplication of the renal pelvis each pelvis having three calyces the lower calyx of the upper kidney joining the upper calyx of the lower kidney. On the left side there was a sharp angulation of a single ureter at the ureteropelvic junction and an incomplete duplicate of the pelvis of the kidney. This patient was relieved of his acute symptoms under colonic and pelvic lavage.

**CASE 7** *Duplication of left renal pelvis*. The patient a man aged 34 was seen April 10 1918. One month before he had been seized with severe pain in the left lumbar region radiating to the groin. This was relieved by passing a long thin blood clot. Since then hematuria had persisted with moderate vesical irritability. Cystoscopic examination showed a slightly congested trigone—that the blood was coming from the left ureter. Catheterized specimens showed a negative urine on the right side the left contained much blood pus cells and colon bacilli with deficient function. A pyelogram revealed a double kidney pelvis on this side.

**CASE 8** *Incomplete duplication of right renal pelvis*. The patient a woman aged 46 married American was examined by my associate F. L. Du Bois on March 7 1918. Her history was that nine months ago she began to have frequency at night and voided every two hours by day. This condition has persisted. She then voided every two hours night and day with burning. Both kidneys were palpable but were not tender. Cystoscopic examination revealed a congestion of the trigone and vesical neck. The ureteral orifices were normal and a catheter passed 34 centimeters on



Fig. 20. Right kidney located and not rotated. (Case 13.)

each side. There was a rapid flow of urine from each kidney which on examination showed pus cells colon bacilli and an equal function. Reontograms with X-ray catheters in position showed a prolapse of the right kidney with the patient in the erect posture and a pyelogram revealed duplication of the renal pelvis.

**CASE 9** *Incomplete duplication of right renal pelvis*. A woman aged 52 American widowed was seen in consultation June 7 1917. She complained of pain in the right upper quadrant and frequent burning urination of six months duration. Gastric distress constipation and jaundice had been noted for the previous three weeks. There was tenderness and rigidity of the right rectus. The urine was highly colored. The bladder showed hyperemia of the trigone the ureteral orifices were normal catheters passed 30 centimeters on each side. The urine from the right kidney was cloudy contained blood cells pus and colon bacilli while the left kidney excretion was negative. The function of the right kidney was diminished one third. A pyelogram revealed an incomplete duplication of the right kidney pelvis. An exploratory laparotomy of the right upper quadrant of the abdomen was made. The report gave acute cholecystitis with obstruction of the cystic duct as the primary lesion giving rise to the abdominal symptoms.

**CASE 10** *Incomplete duplication of both kidney pelvis*. The patient a woman aged 4 American married was first observed in 1916. She complained of pain in the left side of the abdomen and back.







Fig. 23 Tuberculo of single functional kidney (Case 18)

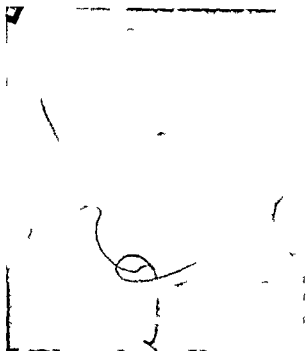
ing of epigastric pain, nausea, vomiting, frequent burning urination extending over a period of three months. A globular mass which was of the size and shape of a kidney could be felt on the right side of the abdomen at the level of the umbilicus. Cystoscopic examination revealed a congested bladder, normal ureteral orifices. A catheter passed 25 centimeters along the right ureter, 31 centimeters on the left side. The urine from each side contained pus cells and colon bacilli on culture. The renal function was normal. A double pyelogram showed that the right kidney had not rotated, the renal calyces pointing toward the vertebral column, nor had it ascended to its normal position in the lumbar region. There was no kinking of the ureter and the left ureter and kidney were in normal position. A laparotomy revealed an undescended caecum and a diseased appendix. The appendix was removed.

CASE 14 Migration of kidney to opposite side in their ascent crossed ureters. This patient, a woman aged 33, married, came under observation October 13, 1914. She complained of frequent painful urination which had persisted and become progressively worse over a period of ten years. This was accompanied by loss of flesh and strength. Physical examination was negative. Cystoscopic examination was exceedingly painful owing to a contracted and highly sensitive bladder which retained but two ounces of fluid. The examination revealed well marked edema, congestion and ulceration of the right side of the trigone and bladder wall particularly in the immediate neighborhood of the dilated rigid right ureteral orifice. The left ureteral orifice appeared normal and there was but

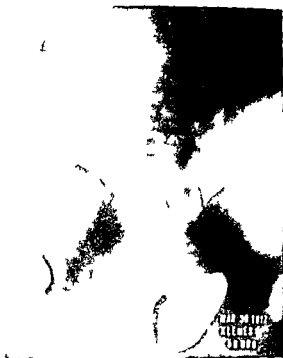


Fig. 24 Bilateral lupul catin of ureter (Case 19)

slight congestion immediately about it. A catheter entered either orifice but was obstructed 15 centimeters from the bladder on the right side and 17 centimeters from the bladder on the left side. No specimen could be obtained. Indigocarmin returned in good amount from the left ureteral orifice in five minutes. None was emitted from the right ureteral orifice in 25 minutes. The bladder urine showed large quantities of pus and numerous tubercle bacilli. A diagnosis of tuberculosis of the right kidney was made and as a subsequent cystoscopic examinations it was found impossible to pass the ureteral catheter beyond the points above noted the right kidney was removed without splitting it. This kidney after removal showed pyelonephritis only but no tuberculous lesions. The patient died of uremia seven days after operation and at autopsy it was found that the ureter leaving the left lateral angle of the trigone passed back of the bladder, crossed the right ureter and ascended in the right side of the abdomen to the right kidney while the ureter from the right side of the bladder passed in a like manner to the left kidney. Thus the urine from the right kidney was emitted from the left ureteral orifice in the bladder and that from the left kidney from the right ureteral orifice. The left kidney was almost entirely destroyed with tuberculosis, the ureter the seat of strictures the lowest being one half centimeter from its point of entering the bladder wall. The right kidney which had been removed was com-



I O U T A f i f t t a



I t a t t l l l t l f l k l (C)

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d u p l i c a t i o n T h p a t i e n t a s r e l e e d b y r e l v c  
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CASE 1. The patient a woman aged 46  
complained of pain in the right upper quadrant.  
The pain was dull in character and persisted for  
seven weeks and was accompanied by frequent  
burning urination. The right kidney could be pal-  
pated as a lightly enlarged and tender. Cy-  
toscopic examination revealed a moderate congested

of the urethra and trigone. Catheter passed to  
either kidney 31 centimeter. The left ure-  
ter negative. The right kidney and colon bac-  
terial pyelogram revealed a complete duplica-  
tion of the right renal pelvis.

#### ANATOMY OF POSITION OF KIDNEY

CASE 2. Bilateral kidney. The patient  
a woman Italian, 60 years of age, an ap-  
parently healthy woman, under obser-  
vation July 20, 1913, for pain in the right lo-  
quadrant. This was no relief by the per-  
tinent physical examination. The patient  
on her feet. A small regular mass could be palpated  
in the right lower quadrant and the lower pole  
of the right kidney could be palpated above the  
cystic copic mass. The renal pelvis  
demonstrated no maluretericosis. The cateter  
the right ureter passed 30 centimeters to the  
left 26 centimeter. The 10 from the right cathe-  
ter was to see the amount of that from the left a  
d the function and capacity of the same portion  
Culture showed staphylococcus aureus from the  
left. The negative culture from the right. A double  
pyelogram showed both kidney placed on the right  
side of the abdomen. The right above the left  
the latter being an organ of frontal type. The  
patient was greatly relieved by pelvic lavage.

CASE 13. Right kidney and left kidney. The  
patient a woman American aged 40 married  
came under observation in January 1914. The

normal ureteral orifices in each lateral angle of the trigone. Catheters entered each orifice and passed 31 centimeters. The urine from each was negative other than the presence of a few pus cells and colon bacilli. A roentgenogram taken with catheters in each ureter revealed four ureters distinct enough to show the anterior ureter having the higher insertion into each renal pelvis. No pyelogram was made so we were unable to ascertain whether there was a duplication of the pelves.

**CASE 20 Duplication of ureter on left.** A woman aged 29 was sent for treatment in 1900. She complained of chronic constipation, frequent painful urination and discomfort in the right lumbar region. The right kidney could be palpated was slightly enlarged and tender.

A cystoscopic examination revealed a contraction of the entire bladder mucous membrane more marked on the right side in the region of the lateral angle of the trigone. On this side there were two ureteral orifices. A catheter entered each and passed 30 centimeter. Cloudy urine containing pus, blood and colon bacilli was discharged through each catheter. There was a single ureteral orifice on the left side. A catheter passed 31 centimeters to this kidney with ease and the urine obtained was normal.

The right kidney was exposed through a lumbar incision and proved to be slightly enlarged, prolated and very much congested but otherwise normal. There were two ureters leading from a single pelvis. The ureters were slightly dilated but not thickened.

The kidney was denuded of its capsule and sutured as high up as possible.

**CASE 1 Bilateral duplication of ureter.** A woman single aged 36 was seen in 1910. The chief complaint was frequent painful urination over a period of fifteen years. Physical examination was negative. Cystoscopic examination showed a urethral stricture of small calibre. This was dilated and a cystoscope introduced. The area of the trigone showed hyperaemia and in each lateral angle were two apparently normal ureteral orifices. They were about 1 centimeter apart. A catheter entered each and passed 30 centimeters. Urine from each kidney was normal. No roentgenogram was made.

**CASE 2 Bilateral duplication of ureter.** A male aged 4 came in 1912 for an operation for hypospadias the floor of the terminal 3 centimeters of the penile urethra being absent. There was no venereal history and the physical examination was negative. A cystoscopic examination revealed in an otherwise normal bladder two ureteral orifices on each side in relatively the same position, one in the lateral angle of the trigone about 1 centimeter apart, the second being posterior to and to the outer side of the first. The appearance of each opening was normal. The catheter was passed into each orifice and advanced 31 centimeters. The urine from each side was normal. A roentgenogram with shadow catheters in position on one side verified the diagnosis.

**CASE 23 Bifurcation of lower ureter.** The patient a woman aged 36 American single came for observation April 2 1918 complaining of frequent painful urination over a period of six months becoming more severe until she then voided every half hour day and night. She had lost weight and strength. There was light tenderness in the left lumbar region. Cystoscopic examination revealed a contracted inflamed bladder the mucosa being congested throughout more pronounced about the left side of the trigone. A ureteral orifice was observed on this side dilated rigid and overhung with an area of granulations. A catheter entered the orifice passed  $\frac{1}{2}$  centimeters when it was seen to emerge from another orifice  $1\frac{1}{2}$  centimeters above and to the outer side of the first orifice. There was a single normal ureteral orifice on the right side of the trigone. A catheter passed 30 centimeters to the right kidney and normal urine was obtained. The bladder urine contained pus and tubercle bacilli. A roentgenogram showed that there was a bifurcation of the left ureter  $1\frac{1}{2}$  centimeters from the vesical opening.

These 3 clinical cases represent 2 single kidneys both the seat of infection, one presenting a calculus obstruction of the single ureter, three fused kidneys, one horseshoe kidney, the seat of tuberculosis and two fused kidneys apparently free from infection but causing pressure in their anomalous position. All six cases showing duplication of the renal pelvis had a pyelonephritis. The six cases presenting one or both kidneys in an anomalous position showed renal infection, one being tuberculous and another having a renal calculus. The six cases showing anomalies of one or both ureters all were the seat of renal infection.

From the above it will be seen that all but two of the cases presented renal infection which indicates that a single kidney called upon to do double work, a malformed or misplaced kidney having poor drainage, poor blood supply and subject to pressure is particularly prone to infection. Anomalies of the ureter also interfere with kidney drainage thus predisposing to infection.

The necessity for assisting such kidneys to perform their function is apparent. The indications are to throw less work upon the kidneys. With four exceptions the infections were all of the colon type. The necessity of attention to the intestinal tract is apparent. Lavage of the kidney pelvis has been bene-

paral ley normal and the ureter was normal. The position of the complete perforation just before entering the left side of the bladder wall.

**CASE 1 Pelvic kidney.** A woman aged 22 years, Jewish, single, first seen in October 1917. She complained of pain in the left lower abdominal region and frequent urination. She was relieved some what following the delivery but the urinary symptoms persisted. The general physical examination was negative other than the presence of a mass easily palpated in the left side of the pelvis. *pelvic tag na*. A cystoscopic examination revealed a well marked cystitis with moderate congestion about the left than the right ureteral orifice. A catheter passed to the right kidney 31 centimeter and a normal flow of clear negative urine as obtained. A catheter passed 3 centimeters on the left side. The urine obtained contained pus, blood cells and colon bacilli. The function of the kidney as left intact being one half that of the other side. A roentgenogram with catheters in position showed a right kidney normal position the left situated the pelvis.

#### ANOMALIES OF URETERS

**CASE 8 Olfert's fistula.** A woman aged 34 years, single, first seen November 1915, complaining of frequent painful urination of 10 minutes standing. She voided every three hours by day and twice at night. There was a urethral stricture at the external meatus which was dilated and five ounces of residual urine found in the bladder. Cystoscopic examination revealed very much congested bladder mucosa with a dilated right ureteral orifice surrounded by an area of edema and posterior to the trigone in the side was a small ulcerated area, high blood cells. No right ureteral orifice could be seen although the trigone as well outlined. The urine from the left kidney contained pus and tubercle bacilli. Repeated examination over a period of six years always revealed the same bladder picture. The left ureter as plugged with a Garceau catheter and four ounces of urine collected from the left kidney. A whole no urine entered the bladder. A pyelogram showed a tuberculous lesion in the left kidney. Exploratory laparotomy in 1917 revealed a small right kidney with a smooth surface and no visible lesions. The pelvis and ureters were slightly dilated the ureter as dilated but not thickened and ended below the pelvic brim in a fibrous cord.

**CASE 10 Pelvic kidney.** A woman aged 40 years, married, first seen in 1916. She had a first pregnancy at 18 years of age, the last pregnancy at 38 years of age. She had suffered from frequent painful urination from vomiting and steady burning down the pelvic region.

On general examination a small, lightly tender mass could be palpated posterior to the uterus in the median line resting on the promontory of the sacrum. The mass had the general contour of a kidney. Cystoscopic examination showed marked pre-urethral in the bladder from the enlarged uterus and an ureteritis. The mucous membrane about the left ureteral orifice as slightly edematous. A catheter passed to the right kidney 30 centimeters with little difficulty. On the left side the catheter passed 1 centimeters. The urine from the right kidney was negative that from the left side was cloudy from pus, contained colon bacilli and showed deficient kidney function. A roentgenogram showed left catheter passing slightly upward from the bladder then directly backward and coiled up in the pelvis of a pelvic kidney. It was the mass palpated through the vaginal vault.

**CASE 17 Pelvic kidney.** A woman aged 22 years, seen three weeks after her first confinement. The labor had been a prolonged and difficult one requiring forceps. During the latter months of pregnancy the patient had complained of frequent painful urination and severe pelvic pain. The pain was relieved some what following the delivery but the urinary symptoms persisted. The general physical examination was negative other than the presence of a mass easily palpated in the left side of the pelvis. *pelvic tag na*. A cystoscopic examination revealed a well marked cystitis with moderate congestion about the left than the right ureteral orifice. A catheter passed to the right kidney 31 centimeter and a normal flow of clear negative urine as obtained. A catheter passed 3 centimeters on the left side. The urine obtained contained pus, blood cells and colon bacilli. The function of the kidney as left intact being one half that of the other side. A roentgenogram with catheters in position showed a right kidney normal position the left situated the pelvis.

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**CASE 9 Blatard's placenta of clots.** The patient a woman aged 32 years, married, was seen December 1916. She complained of backache, headache, pain in the lower abdomen and pelvis and frequent burning urination. She had had three children and had received extensive perineal lacerations. The backache had been severe for four years. For six weeks she had had pain in the right lower quadrant. The uterus as retracted and collapsed. Cystoscopic examination showed light congestion of the vesical trigone and two

normal ureteral orifices in each lateral angle of the trigone. Catheters entered each orifice and passed 31 centimeters. The urine from each was negative other than the presence of a few pus cells and colon bacilli. Roentgenogram taken with catheters in each ureter revealed four ureters distinct throughout the anterior ureter having the higher insertion into each renal pelvis. No pyelogram was made as we were unable to ascertain whether there was a duplication of the pelvis.

**CASE 10 Duplication of ureter one side** A woman aged 9 was sent for treatment in 1909. She complained of chronic constipation, frequent painful urination and discomfort in the right lumbar region. The right kidney could be palpated was slightly enlarged and tender.

A cystoscopic examination revealed a change in position of the entire bladder mucous membrane marked on the right side in the region of the lateral angle of the trigone. On this side there were two ureteral orifices. A catheter entered each and passed 30 centimeters. Cloudy urine containing pus, blood and colon bacilli was discharged through each catheter. There was a single ureteral orifice on the left side. A catheter passed 31 centimeters to this kidney with ease and the urine obtained was normal.

The right kidney was exposed through a lumbar incision and proved to be slightly enlarged, prolated and very much congested but otherwise normal. There were two ureters leading from a single pelvis. The ureters were slightly dilated but not thickened.

The kidney was denuded of its capsule and sutured as high up as possible.

**CASE 11 Bilateral duplication of ureter** A woman, single, aged 36 was seen in 1910. The chief complaint was frequent painful urination over a period of fifteen years. Physical examination was negative. Cystoscopic examination showed a urethral stricture of small calibre. This was dilated and a cystoscope introduced. The area of the trigone showed hyperæmia and in each lateral angle were two apparently normal ureteral orifices. They were about 1 centimeter apart. A catheter entered each and passed 30 centimeters. Urine from each kidney was normal. No roentgenogram was made.

**CASE 22 Bilateral duplication of ureters** A male aged 4 came in 1912 for an operation for hypospadias, the floor of the terminal 3 centimeters of the penile urethra being absent. There was no venereal history and the physical examination was negative. A cystoscopic examination revealed in an otherwise normal bladder two ureteral orifices on each side in relatively the same position, one in the lateral angle of the trigone about 1 centimeter apart, the second being posterior to and to the outer side of the first. The appearance of each opening was normal. The catheter was passed into each orifice and advanced 31 centimeters. The urine from each side was normal. A roentgenogram with shadow catheters in position on one side verified the diagnosis.

**CASE 3 Bifurcation of lower ureter** The patient a woman aged 36 American single came for observation April 2, 1918 complaining of frequent painful urination over a period of six months becoming more severe until she then voided every half hour day and night. She had lost weight and strength. There was slight tenderness in the left lumbar region. Cystoscopic examination revealed a contracted, inflamed bladder, the mucosa being congested throughout more pronounced about the left side of the trigone. A ureteral orifice was observed on this side dilated, rigid and overhung with an area of granulations. A catheter entered the orifice, passed  $2\frac{1}{2}$  centimeters when it was seen to emerge from another orifice  $1\frac{1}{2}$  centimeters above and to the outer side of the first orifice. There was a single normal ureteral orifice on the right side of the trigone. A catheter passed 30 centimeters to the right kidney and normal urine was obtained. The bladder urine contained pus and tubercle bacilli. A roentgenogram showed that there was a bifurcation of the left ureter  $1\frac{1}{2}$  centimeters from the vesical opening.

These 3 clinical cases represent 2 single kidneys, both the seat of infection, one presenting a calculus obstruction of the single ureter, three fused kidneys, one horseshoe kidney, the seat of tuberculosis and two fused kidneys apparently free from infection but causing pressure in their anomalous position. All six cases showing duplication of the renal pelvis had a pyelonephritis. The six cases presenting one or both kidneys in an anomalous position showed renal infection, one being tuberculous and another having a renal calculus. The six cases showing anomalies of one or both ureters all were the seat of renal infection.

From the above it will be seen that all but two of the cases presented renal infection which indicates that a single kidney called upon to do double work, a malformed or misplaced kidney having poor drainage, poor blood supply and subject to pressure is particularly prone to infection. Anomalies of the ureter also interfere with kidney drainage thus predisposing to infection.

The necessity for assisting such kidneys to perform their function is apparent. The indications are to throw less work upon the kidneys. With four exceptions the infections were all of the colon type. The necessity of attention to the intestinal tract is apparent. Lavage of the kidney pelvis has been bene-

ficial and permanent drainage often for several days with the ureteral catheter has proved efficacious. The surgical indications are to improve drainage and relieve pressure if necessary by placing the kidneys in more nearly their normal position to remove any obstruction to renal drainage (as a calculus) to remove a diseased kidney when destroyed beyond repair if the opposite kidney is able to carry on the necessary function or in rare cases to remove the kidney which cannot be replaced and is causing pressure symptoms due to its malposition. Whenever an abdominal mass is found a renal anomaly must be excluded. If it is not possible to make a positive diagnosis of the extent of the lesion before operation the operation should include an exploration of both kidneys.

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system represented by the straight collecting tubules. Each organ is formed independently and possibly as a result of changes in the line of curvature of the caudal extremity of the spinal column ascends until by the end of the third month of foetal life has reached its adult position. Fusion of the renal masses as in this case could cause retardation in the ascent, probably as a result of the development of the aural promontory which could offer obstruction to the isthmus in the midline and prevent the normal passage upward of the lateral mass along the rhombic foramina. Nature ascends the renal tissue through the renal vessels and this would contribute to the difficulty of ascent as illustrated by the markedly angular course of those renal arteries in our specimen which are derived from the anterior surface of the aorta near its bifurcation. It is our conception that the dumb bell type illustrates fusion of the poles of the primitive kidneys which in a certain sense were rotated as it were on their backs and transposed as a direct result of retardation in ascent of the midportion or isthmus.

Congenital fusion of the kidneys find its most frequent expression in the horseshoe kidney. There are various intermediate forms of union between the two which Rokittansky call the lower degree of fusion and the highest degree of fusion is merely when the kidney is fused into a single mass lying usually in the median line and placed downward and often provided with a double pelvis and two ureters.

Clinical importance. The malformed kidney as a rule gives rise to no clinical symptom unless complicated or through pressure as the result of misplacement. Any disease to which the normal kidney is subject may affect the malformed organ but hydronephrosis and its frequent sequel pyelonephrosis are the most frequent complications. Pressure of the anomalous vessel on the ureter is the cause in the majority of cases as shown by William I Mayo (Proc Surg Ass 1913).

Important steps in the recent progress of the surgery of the horseshoe kidney are the division of anomalous blood vessel causing ureteric obstruction, division of the isthmus to relieve pre-sympyctomy, ureteropelvic anastomosis, plastic operation on the renal pelvis for hydronephrosis and heminephrectomy by the transperitoneal route.

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A review of the records of abdominal operations at St Mary's Hospital (Mayo Clinic) for the past five years shows that gross renal and ureteral anomalies were found in thirty six patients. Of this number eight were operated on for various pathologic conditions complicating the anomaly and seven were operated on for abdominal conditions other than those of the kidney, the discovery of which as largely incidental to the general abdominal exploration. In the last thirty years the records of those cases in St Mary's Hospital showed that congenital anomaly was diagnosed clinically in fourteen patients of this number four were not operated upon for various reasons. Postmortem records of the last one hundred and eighty one autopsies made at the clinic showed that congenital anomaly of the kidney and ureter as noted in seven cases or over 4 per cent of the total. This

number includes only those gross anomalies occurring in the adult that might be regarded of surgical importance and does not include minor anomalies so frequently found in the urinary tract such as supernumerary and aberrant renal blood vessels, fetal lobulation, moderate degree of malposition nor those rather frequent instances of partially deformed atrophic kidneys which may be due either to congenital or acquired etiologic factors.

The pathologic condition existing in the anomalous kidney or ureter usually call our attention clinically to its existence. That such kidneys are peculiarly liable to disease has been noted by various observers. The frequency with which such anomalies are found in a surgical clinic as compared with postmortem records of a general hospital would therefore be at least partially explained by the fact that the complicating conditions usually require surgical treatment.

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## TUBAL AND OVARIAN HÆMORRHAGE

ITS ETIOLOGICAL RELATION TO PELVIC HÆMATOCELE AND EXTRA UTERINE PREGNANCY<sup>1</sup>

By J. WESLEY BOVEE, M.D., I.A.C.S., WASHINGTON

## CAUSES

**I**N considering ovarian and tubal hemorrhages I am excluding those forms arising from tubal pregnancy and from overwhelming trauma or hæmophilia. Many case reports were of virgins and one in a woman past the menopause.

## FREQUENCY

Without careful study of ovarian and non-pregnant tubal hemorrhage one might think its occurrence was so rare as to be a novel or grotesque condition. But careful analysis of abdominal surgical work including microscopic study will demonstrate that it is not a rare condition. As an instance I may here recite briefly the history of a patient seen one night last month with Dr. A. L. Staveland.

A spinster of 32 years usually tardy in menstruation that habitually lasted seven days and had ceased menstruation the day before fell in the street at midday from sudden and severe pain in the hypogastrium while on a shopping trip. She was removed to the office of an osteopathist who had been treating her for constipation and vague abdominal pains. She required the patient to drink large quantities of salt water which failed to cause vomiting. In the evening there was general abdominal rigidity though I was told two doses of morphine had been taken during the preceding two hours. The temperature was slightly above 100 F. and pain was not a special feature. She chatted with me while I made a vigorous abdominal examination that revealed retroversion of the uterus with some enlargement and fixation of the appendage. Dr. Staveland and I could not differentiate between ovarian hemorrhage, appendicitis and intestinal perforation but the condition being evidently some grave lesion in the abdomen she was at once opened by Dr. Staveland and a large amount of free blood that had escaped from a small ruptured ovarian cyst the diameter of which he estimated as three inches was found. No other reason for the attack was found.

Other cases might be cited to show the frequency of the condition and particularly that it is often a grave one. Novak reported a collection of 40 cases and Joly 17 three of which were his.

Trauma plays a part in producing these hemorrhages as instanced in the cases reported by Freeman Primrose and many others. The ingestion of poisons of various kinds are reported as exciting causes. The ingestion of oxytocics and emmenagogues to interrupt a supposed pregnancy especially when it did not exist has been the cause in many cases. No doubt toxic conditions predispose to these hemorrhages. Inflammatory changes and other pathologic conditions including neoplasms are causative agents. Possibly instability of ovarian tissue and maladjustment of the internal secretions at puberty are provocative.

*Hæmorrhage from the fallopian tube* may occur from general conditions that similarly effect other tissues and need not be considered here. Venous stasis from circulatory disturbances or pressure from tumors may be occasionally included in a list of its causes. Vicarious menstruation may occur in the tube as well as from mucous membranes in different parts of the body. While I have not found case reports in the literature I believe it can occur in infancy as well as can hæmorrhage from the ovary as described by Tate, B. Schultze and others or from the uterus a condition often reported by careful observers. Tubal neoplasms especially carcinoma may give rise to severe hæmorrhage. Local infections probably constitute a frequent cause of tubal hæmorrhage. Exposure to cold particularly during or immediately before menstruation has been regarded by several reporters as the cause of ovarian hæmorrhage. Doran reports the case of a woman critically ill from a supposed ruptured tubal pregnancy in which he found a large hæmatocele formed from blood escaping from the fibrinated end of a tube that was neither ruptured, pregnant, enlarged or inflamed. No cause for the hæmorrhage was given. Beyond doubt tubal pregnancy is the cause in a preponderating pro-

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*Hæmorrhage from the fallopian tube* may occur from general conditions that similarly affect other tissues and need not be considered here. Venous stasis from circulatory disturbances or pressure from tumors may be reasonably included in a list of its causes. Vicarious menstruation may occur in the tube as well as from mucous membranes in different parts of the body. While I have not found case reports in the literature I believe it can occur in infancy as well as can hemorrhage from the ovary as described by Tate B. Schultze and others or from the uterus a condition often reported by careful observers. Tubal neoplasms especially carcinoma may give rise to severe hemorrhage. Local infections probably constitute a frequent cause of tubal hemorrhage. Exposure to cold particularly during or immediately before menstruation has been regarded by several reporters as the cause of ovarian hemorrhage. Doran reports the case of a woman critically ill from a supposed ruptured tubal pregnancy in which he found a large hæmatocele formed from blood escaping from the fimbriated end of a tube that was neither ruptured pregnant enlarged or inflamed. No cause for the hemorrhage was given. Beyond doubt tubal pregnancy is the cause in a preponderating pro-

portion of tubal hemorrhages. Inflammatory infiltrations which compress and obstruct venous return from the tubes is thought to be the next most frequent cause.

*Ovarian hemorrhage* may be confined within the ovary constituting one or more hæmatomata or it may take place into the peritoneal cavity producing an abundant an hæmatocele. In the former variety it may occur in the stroma into new growths or into follicles in any state of development. Several such hæmatomata may coalesce. Both may occur coincidentally and in fact it is thought follicular may lead to stromal and *vice versa*. Between 1850 and 1859 Nélaton, Rokitsansky and Iueh had published their monographs on every follicular hemorrhage. If before or during follicular hemorrhage rupture of the follicle or of the wall about a stromal active hemorrhage occurs the peritoneum may be deluged. Slight hemorrhage from the follicle is regarded as a normal incident of ovulation. But the loss of more than a slight amount of blood in this manner must be regarded as pathological. Ovarian hemorrhage nearly always occurs during menstrual life. Probably its occurrence in the postclimacteric period of life is very rare. R. H. Harte reports the case of a woman long past the menopause who while riding in a carriage was seized with a severe attack of abdominal pain in the region of the appendix vermiformis. She had a history of chronic appendicitis and the inference was that that disease was the cause of the pain. Not improving in bed the abdomen was opened to find the abdomen filled with blood and an ovary ruptured across with free hemorrhage from it going on. The ovary was found to contain an angiosarcoma. Several cases at birth have been reported and many striking ones chronologically near or during the first menstrual period though these two epochs in life cannot be regarded as having notable predilection for ovarian hemorrhage. Probably conditions of the ovary at the time of menstruation afford the most potent factor in predisposition. Certainly a very large proportion of the reported cases have occurred during or within three days of menstruation. Bloodgood's 2 cases

occurred the day before menstruation was expected. This synchronization between menstruation and ovarian hemorrhage has been well fixed in our minds since Scanzoni reported his celebrated case in which at autopsy on the body of a young girl who had died during menstruation he found three liters of blood in the peritoneal cavity clearly from a ruptured ovarian follicle. Many like reports are recorded in the literature of the Surgeon General's Library. Ovarian pregnancy was the cause in one of the 35 cases of death from ruptured ectopic pregnancy reported by Formad. But as less than 5 authentic cases of this form of pregnancy have been reported its share in etiology must be regarded as small—quite in contrast with tubal gestation in this relation.

The form of ovarian hemorrhage by far the most frequent and most interesting will be discussed more fully in taking up the pathology of these hemorrhages.

#### PATHOLOGY

No other organ of the body is so frequently the seat of hemorrhage as is the ovary and a large amount of literature has been written on the pathology of the ovary in ovarian hemorrhage. Much of it is repetition. I shall not discuss the pathology of hemorrhage into the wall or the interior of ovarian cysts at or subsequent to twisting of the pedicle which is far from infrequent nor will I take up ovarian pregnancy.

*Stromal hemorrhage* is commonly preceded by infection of the ovary. Chronic ovaritis results in the development of additional connective tissue which frequently prevents rupture of the graafian follicle and retains it as a cyst. A clerocystic condition is produced and fatty degeneration of the blood vessel walls of the stroma follows. In the prolonged ovarian congestion incident to ovulation or attempted ovulation the blood vessel walls rupture allowing the escape of blood either into the stroma or into the cysts retained in one or several areas. This may also occur without ovaritis as is well shown in the case reported by Whitehouse which occurred in a single woman of 40 years and whose menstrual periods since puberty at

16 years had each time been distressingly painful in spite of dilatation of the cervix uteri and curettage. The removed ovaries each contained on section multiple petechial or punctiform hæmatomata most numerous in the subcortical layer with no extensive extravasation at any place. Corpora lutea of different stages of retrogression were present. The blood cells were found free in spaces and confined within vessels. Frequently a recent hæmorrhage was found abutting against one of longer duration the contrast being very evident. There was no evidence of excess in fibrous tissue or of inflammation. Several writers speak slightly of the pathological and clinical significance of stromal hæmorrhage. But the pathologist and surgeon of gynecology lacks such disregard for the gravity of this form of ovarian hæmorrhage. Generally speaking it must be regarded as a product of sclerocystic degeneration—chronic oöritis a condition decidedly prejudicial to the integrity of the organ. Yet one cannot discredit the follicular form as a cause of the stromal variety. Moreover infection is not apt to be a complication of stromal hæmorrhage. Several authors have written quite lengthily of the pathology of ovarian hæmatoma including corpus luteum cysts and I shall pass over that subject making only a few suggestive statements. The theca interna of the maturing follicle contains a richly supplied plexus of small blood vessels which penetrate to the tunica granulosa. Following the rupture of the follicle in the earliest stages of the corpus luteum a much richer blood supply is developed and is termed by writers as the stage or period of hyperæmia. These blood vessels are specially well developed next to the tunica granulosa and become smaller there when the lutein layer is completed. But the thecal vessels remain prominent until retrogression of the corpus luteum is nearly completed. In a large proportion of follicles death of the ovum occurs in an early stage of development and a gradual degeneration of the tunica granulosa takes place. As a result of this death at various stages of development of the follicle a great variety of follicular cysts is found with walls varying from a single layer of cuboidal

epithelium to several layers. The cavities are found in various stages of atresia resulting from absorption of surrounding cell layers fibrous tissue taking their place and producing the corpus fibrosum to be distinguished from the corpus albicans—the terminal structure of the corpus luteum. These transitions were well shown in the case of Whitehouse. Some writers state the follicular form of hæmorrhage is much rarer than supposed and that the atretic follicle is by far the most frequent site of ovarian hæmorrhage. I believe this statement is true but practically we should attach but little importance to it as clinically the time of predilection of such hæmorrhage into atretic follicles when of severe type is during or very near menstruation—the usual time of severe hæmorrhage from follicles. Moreover the atretic follicular form is usually not attended by such grave symptoms as appear with hæmorrhage into the follicle or corpus luteum. Exceptions are those rare cases in which rupture of the ovary with hæmorrhage occurs somewhat as in the case of the ruptured tube. The large follicle nearly or completely developed is far more easily ruptured with alarming symptoms than is the atretic follicle though the much greater number of the latter might make the incidence of the site of hæmorrhage in favor of it. Hæmorrhage from the corpus luteum with resulting intraperitoneal hæmatocele seems so simple and easy that one wonders at its infrequent recognition. Like early tubal gestation it may occur in a small degree without notable clinical evidence and probably often is unrecognized before operation or autopsy in but a marvelously small percentage of cases. Under such conditions to doubt that slight ovarian hæmorrhages may occur without even suspicion is illogical.

The large number of cysts often seen in the ovary is not wholly indicative of a sclerocystic condition i.e. the ovary that is undergoing chronic inflammatory changes and commonly has constricted zones outlined on the surface by girdling grooves underlaid by fibrous tissue though earlier before contractions have taken place the surface resemblance to the cystic ovary is strikingly great. The so called cystic degeneration is produced

by overstimulation in the process of maturation of follicles which have aborted and become atretic follicular cysts. It may be well to mention in passing that cystic ovaries are indicative of ovarian hyperstimulation and overactivity rather than of hypofunction and disease and *caeteris paribus* to be preserved rather than ablated. The serocystic ovary does not or should not enjoy such favorable consideration. No doubt hemorrhage into these cysts is very common and equally probable is it that it results in unimportant phenomena. However this result is not always so innocent. As these atretic cysts are so remarkably thinly lined before they become corpora fibrosa and are surrounded by such a great development of young blood vessel hemorrhage into them might be expected to occur commonly. Probably the high degree of intracystic pressure is really greatest at this juncture from general ovarian hyperemia and which to a greater or lesser degree neutralizes intravascular pressure accounts for it. It often occurs that such hemorrhages into multiple cysts cause multiple hematomata which coalesce to form large hematomata. Either the small or the large ones may rupture into the peritoneum with more or less severe resulting hemorrhage when once the intracystic tension is removed. The naked eye appearance of such conditions does not enable one to distinguish the cystic from the sclerotic ovary unless the presence of protruding ovarian adhesion or girdling constricting bands of fibrous tissue are present. The microscopical evidence however should be ample for differentiation. Often the intracystic pressure is sufficient to prevent invasion by blood that escapes from the perifollicular zone of new blood vessels small infarcts more or less zonal in shape forming outside the cyst lining and easily becoming stromal hematomata.

In the corpus luteum the granulosa zonal plexus of blood vessels is probably more extensively developed than in the atretic form of follicle and in addition vascularization inside the follicle takes place the two processes overlapping chronologically in fact. The vascular area forms a luteal layer that

is in turn abundantly supplied by capillaries from the perigranulosa area. At this time a moderate amount of blood escapes into the cavity of the corpus luteum and becomes adherent just within the layer of the luteal tissue. Early in the development of the corpus luteum in fact until the corpus luteum is well matured hemorrhage may occur from the vascularized area into the luteal cavity and perhaps the blood be poured into the peritoneal cavity. Hemorrhage into the luteal cavity may be so great as to interfere markedly with the process of maturation. Later however this type of hemorrhage is less liable to occur as the blood vessel walls become more resistant as do the wall of the corpus luteum.

#### SYMPTOMS

Non gestational tubal hemorrhage probably has no diagnostic symptom or symptom complex. The symptoms of ovarian hemorrhage are by no means distinctive. They vary from none known in cases in infancy found in autopsies to those at puberty resembling very closely dysmenorrhea of ovarian or cervical origin and even to those severe attack that have caused death or led to emergency abdominal sections. Usually a history of sudden exertion that indirectly influenced the pelvic region has been followed by a very severe degree of pelvic pain proximal or quite continuous. Sometimes the pain is referred to the umbilicus or epigastrium gradually limiting itself to the affected iliac fossa or lower abdominal zone vomiting and collapse soon following. In some cases the pain has been well distributed throughout the abdomen and pelvis. General tenderness and muscular rigidity of the whole abdomen is usually present. Vaginal abdominal examination reveals great tenderness about the appendages. Wilton is the shock where there is no actual peritoneal hemorrhage is out of all proportion to the extent of the lesion found. He states the two cardinal symptoms are abdominal pain and uterine hemorrhage. Other observers scarcely subscribe to this statement but place stress upon interference with abdominal movements of respiration. As many of the cases occurred at or very near the menstrual period

the value of uterine hæmorrhage may be questioned

Slight cases may clear up in a few days but the severer types offer no such happy result. Wilson thinks interruptions of the menstrual periods from cold with severe pains so common in young girls are often cases of ovarian hæmorrhage.

Probably careful analysis of a case would permit differentiation of the variety as in early infancy and early menstrual activity the follicular variety would be most likely and the corpus luteal and stromal to be least common. As infections become more common in later years the incidence of the stromal variety would seem to be increased. Moreover stromal and corpus luteal hæmorrhages would not be so common at or very near the menstrual period.

Clinical observation bears out this statement. In the stromal variety a history of irregular or delayed menstruation is present and to this is often added evidence of long standing pelvic disease. In several instances the history was strikingly significant of tubal pregnancy. I have a very strong conviction that the diagnosis of ovarian hæmorrhage will be as clear as of ectopic gestation and its subdivisions easier to differentiate than are tubal abortion and tubal rupture.

#### DIAGNOSIS

In but few cases have correct diagnoses been made before operation or autopsy. One can most easily realize this fact by reading Primrose's paper and the discussion of it in the thirtieth volume of the transactions of the American Surgical Association (1917). Research of the literature presents an alarming picture with its reports of cases of ovarian and tubal hæmorrhage that had symptoms calling for immediate surgical treatment or having a rapidly fatal termination without previous recognition. Many have first been suspected at autopsy. Probably many in the future will not be decided by either of these procedures alone. In these the microscope will be of paramount importance in making the positive diagnosis. This statement has been indelibly impressed upon me by its use in my doubtful cases of ectopic

gestation. In 1897 I brought this matter to the attention of the Southern Surgical and Gynecological Association and in 1914 to that of the Gynecological Section of the American Medical Association. Last year I again presented it to the first named organization. This then is my fourth paper on the subject written as an appeal to my confreres for more attention to be given to the subject of ovarian and tubal hæmorrhage not due to pregnancy. It must be distinguished from tubal pregnancy, ulcer of the intestine, appendicitis and ingestion of poisons. I need not dwell upon this phase of the subject. My paper of 1904 referred to was based upon 10 cases of supposed ectopic gestation in which the microscope refuted the diagnosis. In December 1917 I reported upon 19 later cases, 15 tubal and 4 ovarian with the same postoperative provisional diagnosis. Microscopical reports on these reject 13 tubal and all of the ovarian cases. I am confident several of these cases had as much local evidence of pregnancy as many I have seen in the hands of others in which the microscopical diagnosis was accepted without question. One can easily appreciate the rank injustice of such an incomplete diagnosis in virgins and widows.

#### PROGNOSIS

I have already referred to the tragic character of many cases of these forms of intraperitoneal hæmorrhage. Their gravity may be appreciated when it is recalled that many of the foremost abdominal surgeons of the last 40 years have done emergency operations for their relief under the diagnosis of ruptured tubal pregnancy, appendicitis, etc. Among these may be mentioned Alban Doran, Edgar Calabin, Hind, J. A. Lee and Tate. Depage reports a case of intra-peritoneal rupture of an ovarian hæmatoma in which he promptly operated with a diagnosis of acute appendicitis with perforation. Primrose reports cases which I have abstracted as follows:

CASE 1. A woman of 35 years, mother of twins of 3½ years, her only pregnancy lifted a heavy chest two days before a menstrual period was expected and experienced sudden severe pain



in the hypogastrium nausea and vomiting. He found her twelve hours later anæmic having a pinched and anxious expression temperature 99.6 F and pulse 130 marked abdominal distention and uniform rigidity. Palpation at once induced vomiting general abdominal tenderness but most marked in left lower quadrant. Abdominal section revealed a very large quantity of blood in the abdominal cavity and a ruptured hæmorrhagic cyst in the left ovary from which arterial blood was spurting in a pulsatile fashion.

CASE 2. Exceptionally active woman of 40 years two days before a menstrual period was due was awakened at 2 a. m. with pain in abdomen. Seen 16 hours later the temperature was normal but severe local pain and vomiting were present. Operation four hours later for appendicitis through right lateral incision. Fluid blood oozed up into the wound and a midline incision was made. A large amount of blood fluid and coagulated blood was found. The right ovary considerably enlarged contained a ruptured follicle from which the hæmorrhage occurred. No microscopic evidence of pregnancy or malignancy was found.

Bloodgood reports two cases of pelvic hæmatomata in which operation with a provisional diagnosis of appendicitis was done one day before the menses were due. One was tubal and the other ovarian in origin. Ellsworth reports a case of a girl of 18 years operated on in first 24 hours for appendicitis. The appendix was found to be normal and there was notable intraperitoneal hæmorrhage. A small laceration was found

in the fallopian tube one inch from fimbriae and from it bleeding was continuing. The microscope revealed no evidence of pregnancy. Leonard Freeman reports the case of an athletic young woman who in vaulting over a fence experienced violent pain in the lower part of the abdomen and went into collapse. The abdomen was opened and the fallopian tube found torn near its middle. The uterus and appendages appeared otherwise normal with no evidence of pregnancy.

#### RELATION TO PELVIC HÆMATOCELE

Pelvic intraperitoneal hæmorrhages of various structures go to make up the immediate causes of pelvic hæmatocele. But non-gestational tubal and ovarian hæmorrhage next to tubal pregnancy are the chief causes and should always be considered in connection with such hæmatocele. Particularly is this true when such elements as ingestion of poisons, oxytocics or emmenagogues, early menstrual life or postclimacteric trauma or general conditions earlier mentioned occur.

#### TREATMENT

In the milder forms of the condition rest and anodynes may meet all indications. In the severer forms the same rules apply as are employed in treating ectopic pregnancy.

CLINICAL DATA ON CHORIO-EPITHELIOMA WITH END-RESULTS OF OPERATIVE TREATMENT<sup>1</sup>

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THERE probably is no more interesting topic in the whole domain of gynecology than that of chorio epithelioma. An entirely physiological process by slightly overstepping its bounds becomes at once a highly malignant condition with rapid and extensive metastases. Although it is generally associated with gestation it may nevertheless occur in individuals in whom pregnancy can positively be excluded as for example in a very young female or in a male. Its development under these conditions forms a most interesting chapter in pathology. Another curious feature is its occasional development originally in areas more or less remote from the site of the ovular implantation while this remains free from the process. These and several other points in the pathology of the condition form a very tempting topic but as they have already been so fully discussed in the literature by distinguished and capable pathologists the writer felt it would be more within his powers to take up the clinical side which until now has been very much neglected. His contribution upon this aspect of the subject is based upon nine personal cases and upon a close and rather extensive study of the literature. It is generally agreed that there are two varieties of chorio epithelioma, the one highly malignant the other semi benign. The chief interest to us as clinicians is: Are there any means of distinguishing the one from the other? Marchand who undoubtedly is the greatest authority upon the subject and who as we all know has done so much to establish its pathology frankly confesses he has failed to recognize any histological differences between the two varieties. A few pathologists however notably V. Velits, Robert Meyer and Ewing have attempted to point out features of differentiation but their observations have not been confirmed by others. Several eminent pathologists whom the writer has personally interviewed emphatically

stated they were unable to recognize any histological differences. The consensus of opinion therefore at present is that there are no definite histological features characterizing the one variety from the other.

**Frequency.** The number of cases recorded in the literature has been variously stated. For instance Pery in 1910 stated there were 700 cases on record. He has been frequently quoted. The figures are entirely too high. Pollosson and Violet in 1913 made a very careful collection of the recorded cases and they accept Briquet's collection in 1903 of 17 cases. From that date until 1913 they collected 238 more cases making in all 455 cases. From 1913 up to the end of 1917 the writer has found recorded in the literature 69 cases which with his series of 9 cases make a total of 78 cases. Of course it must be borne in mind that during this period the literature coming to us from Germany and Austria has been very scant.

**Etiology.** With very few exceptions pregnancy has preceded the development of the growth it is therefore essentially a disease of fertile women. But as Teacher states whether race, climate or social conditions exert any influence upon its occurrence we do not at present know. The ages at which it has occurred have varied from 17 to 55 years. In the series of 189 cases tabulated by Teacher in 1903 the average age was 33 years, 57 per cent of the total number occurred between the ages of 20 and 40 years but there were 6 cases below 20 and 9 cases over 50 years.

In the writer's series of 78 cases 4 were under 20 years, 13 were between 20 and 25, 1 were over 40 years, of these 8 were 50 and over.

The number of cases below 20 years and over 50 years is of great interest and undoubtedly has some bearing upon the fact that hydatid mole which is the most frequent cause of the growth is more often met with

at the extremes of fertile life. Another factor of interest is that the frequency of the disease runs parallel with the degree of fertility.

In 126 cases of Teacher's series in which the necessary data were available 5 per cent occurred in connection with the first pregnancy, 15 per cent with the second pregnancy,

8 per cent with the second or third pregnancies. On the other hand Briquet's 158 cases in his series of 181 give a much higher percentage with the second and third pregnancies, 33 or 21 per cent with the second pregnancies, 31 or 20 per cent with the third pregnancies and 14 or 47 per cent with the fourth or more pregnancies.

It is interesting to note the period elapsing between the last pregnancy and the development of the disease in other words the period of latency. This very often is not easily defined as it usually has to be based upon the occurrence of the first symptom which is generally hemorrhage or upon the appearance of a characteristic tumor in the vagina or vulva.

The period of latency in the cases recorded has varied from a few weeks to several years the longest period stated is 11 years.

Many writers doubt the accuracy of the long period of latency stated in several cases. They assume that a miscarriage of an early gestation had been overlooked. Be that as it may there are some cases with incontrovertible evidence that several years elapsed between the last possible gestation and the development of the growth. Such a case is reported by Kroising. The patient was 52 years of age 5<sup>1</sup> years before the uterus had been emptied of a hydatid mole. 4 years later both ovaries were removed. At this time the uterus looked perfectly normal. Following the operation there was a complete cessation of the menses 3<sup>3</sup>/<sub>4</sub> years later and 5<sup>1</sup> years after the hydatid molar pregnancy the uterus was removed for metrorrhagia and was found to be the seat of chorio epithelioma.

Bearing upon this point Emil Pies of Chicago<sup>2</sup> has made a most interesting and unique observation. In a uterus containing several fibroids that he removed from a

woman who had not been pregnant for 18 years he noticed a long thread like formation hanging from the left uterine horn. This on microscopic examination proved to be a vein containing degenerated chorionic villi. No chorionic epithelia were found on these villi which according to Dr Pies would account for the non development of chorio epithelioma in that instance. The finding demonstrated beyond a question the long period (in this instance 18 years) during which chorionic villi may remain latent in the system.

There cannot be much doubt that in many of the cases reported with a latent period of a few weeks the growth had already existed before the termination of the pregnancy. In our Case 8 the growth was detected with the exploring finger after manually emptying the uterus of a hydatid mole. Similar cases are reported by Eden<sup>3</sup> Kelly and Worman<sup>4</sup>. In Lick's<sup>5</sup> famous case the growth in the vagina developed during the presence of a hydatid mole in the uterus (fourth month of gestation). Wallart reported a metastatic growth in the eighth month of pregnancy. Von Posthorn, Poter and Wasmer each observed a metastatic growth in the vagina before the expulsion of a hydatid mole. The case reported by Jellinghaus<sup>6</sup> evidently belonged to this class. The patient was curetted for a hydatid mole. She continued to bleed and was again curetted and then subjected to a hysterectomy five weeks after the first curettage. A growth was found in the uterus. Jellinghaus in the writer's opinion evidently failed to recognize the significance of the course of events in his case otherwise he would not make the recommendation that every case of hydatid mole should be subjected to a second curettage three weeks after the first to ascertain whether any cicatric villi are present and if found hysterectomy should be done.

But the treatment of hydatid mole in reference to chorio epithelioma will receive attention later on. Boyce<sup>7</sup> reports an interest

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ing case in this connection. In a fibroid tumor of the uterus complicated with pregnancy which he removed, a chorio epitheliomatous growth was accidentally found in the wall of the uterus.

A most important consideration is the nature of the pregnancy preceding the disease. In Teacher's series of 188 cases, 15 cases or 35 per cent followed hydatid mole, 50 cases or 31 per cent followed abortion, 40 cases or 28 per cent followed labor at or about term, 7 cases or 4 per cent followed extra uterine gestation.

In Pollosson and Violet's series of 4 cases including Briquet's series of 1 case, 20 cases or 45 per cent followed hydatid mole, 13 cases or 50 per cent followed abortion, 99 cases or 1 per cent followed labor at term, 1 case or 25 per cent followed extra uterine gestation, 6 were doubtful.

In Hitschmann and Cristofolotti's series of 240 cases, 116 cases or 48 per cent followed hydatid mole, 73 cases or 50 per cent followed abortion, 51 cases or 1 per cent followed normal labor.

They also give statistics of 100 cases of hydatidiform mole of which 15 or 15 per cent were followed by chorio epithelioma. Teacher is of the opinion that this figure is too high as five of the cases were recorded by Kromer and as they all recovered after operation he is inclined to question the validity of the diagnosis of malignancy. Omitting these cases of Kromer the percentage is 5 which Teacher thinks is still too high.

**Symptomatology.** The most characteristic and prominent symptom is uterine hemorrhage. This as a rule is very profuse and may even be alarming as occurred in one of my cases (Case 1). The second hemorrhage was so great that the patient became markedly exsanguinated in a few minutes and it appeared to me she would have bled to death if I had not at once packed the uterus and vagina tightly with gauze.

However in many instances the bleeding may be only of moderate amount but protracted simulating that which accompanies ordinary placental or decidual residue. As a rule the patient is subjected to a curetage but it is found that the bleeding soon

recurs. This of itself should excite suspicion. But it is not uncommon to read in the literature of cases that had been subjected to as many as four or five or six curettages before the condition was suspected. The persistence and at times very abundant bleeding soon lead to marked anemia with its train of symptoms. Cachexia becomes manifest the patient feels and looks ill and a septic condition may intervene. The latter is particularly prone to occur when several curettages have been done. This occurred in one of the writer's cases (Case 7) the only fatal one in the series.

In growing the tumor occasionally perforates the uterus then there may be a most profuse intraperitoneal hemorrhage simulating ruptured tubal pregnancy of the catclysmic type. T. Wilson<sup>1</sup> reports a case of this kind and a few others are found in the literature. In very rare instances even when the growth is situated at the placental site bleeding may be entirely absent as in a case reported by Lichtenstein.<sup>2</sup> Even amenorrhœa of three or four months duration has been observed in a few cases (Eden, Citarum and others). This singular phenomenon has been observed only in cases following hydatid mole. Pollosson and Violet<sup>3</sup> draw attention to the presence of colic like pains caused by the expulsion of blood clots or of debris of the growth. A dull pain is an accompaniment of the later stages of the disease when the broad ligament becomes involved. Hemoptysis is an important symptom and may manifest itself comparatively early in rapidly advancing cases. It usually indicates the presence of pulmonary metastases (Teacher). In some instances when the symptoms referable to the genital tract were not distinct or absent a diagnosis of pulmonary phthisis was made.

In many cases an early evidence of the disease is the appearance of characteristic tumors in the vaginal walls most frequently in the anterior wall near the urethral meatus. These may vary in size from that of an almond to that of a hen's egg. When they attain the



have presented a very full description of metastases to which I am indebted for many of the following data

Metastases in the lungs are most frequent and their number and size vary very much. Occasionally only one tumor is found which may acquire very large dimensions or more frequently numerous small nodules are found scattered over the entire lung. The most favorable sites are the apices and the bases. The middle lobes are less frequently involved. These metastases may develop insidiously and give no evidence of their presence until found at autopsy. This absence of clinical evidence is dependent upon the site, number and volume of the secondary growths.

In the case of Lindfors<sup>1</sup> and Morison the secondary growths developed to a relatively enormous size.

Next to the lungs the vagina and vulva are the most frequent sites of metastatic growths. On account of their situation they are the most easily discerned. Occasionally a single isolated tumor only is present but more frequently there are numerous small nodules running together forming almost a ring. Their form and their dimensions are most variable as also their location. They may involve the entire vaginal canal or they may occur only at the vulvar orifice or in the folds of the labia majora. They usually occur in the form of small nodular masses underneath the mucosa characterized by their brown or violet discoloration. They have been justly compared to thrombosed varices which they resemble so closely as to be frequently mistaken for them. The consistency is tense and elastic almost fluctuating at times. These tumors grow very rapidly causing necrosis and irregular ulcerations. Occasionally these ulcerations are clean cut and well defined. The vaginal growths when they undergo ulcerations may be attended with profuse and obstinate hemorrhages. They very soon become infected and give rise to a sanious and fetid discharge. The period of the appearance of the vaginal metastases varies considerably. Occasionally they appear in the later stages of advanced cachexia but in

some cases they occur remarkably early and furnish a valuable diagnostic sign.

*Uterine ligaments tubes o aries* The broad ligament is frequently found infiltrated by nodular masses of smaller or larger size. The invasion of the tubes and ovaries is occasionally characterized by small discrete growths discovered only on histological examination. At other times the growths may reach a considerable size readily distinguished by their reddish brown or dark color and their hæmorrhagic aspect on section.

*Liver* Secondary growths in the liver are frequently found at autopsy. Generally the nodules are found disseminated of a size varying from that of a pea to a small nut. In a case reported by Hirschmann the entire liver was literally riddled with metastatic nodules. Pavy<sup>2</sup> observed a case in which there was a tumor 4 centimeters in diameter on the convex surface and a large number of other growths in the depth of the liver. These metastatic growths generally do not give rise to many symptoms. Krawer and Macgregg<sup>3</sup> have noted an increase in the volume of the liver but the existence of a secondary tumor the size of a fetal head was not even suspected in a case of Schmorl<sup>4</sup>.

*Kidneys urinary passages* Nitzel, Fibaldi, Gottschalk and many others have observed secondary growths in the kidneys but the growths usually remained latent. In a case of Davis and Harris a tumor in the left kidney 6 centimeters in diameter did not give rise to a single symptom. The exception occurred in a case of Gottschalk in which the urine contained characteristic plasmodial masses. In this instance it is true the tumor attained the size of a fetal head. Secondary growths have very rarely been observed in the ureter (J. Schmidt) in the bladder (Jacubasch, Krawer, Perski, Marchand) and in the ureteral wall (Holzappel).

Metastases in the central nervous system are also frequently seen to occur most often at the level of the left hemisphere and the most common site is the occipital lobe. They are sometimes found as a single nodule varying in size from a lentil seed to a hen's egg. In other instances they occur in multiple nodules. These secondary growths do not

usually have the hemorrhagic aspect of visceral metastases

In addition to these sites metastases have been occasionally observed in the most diverse organs as for instance in the stomach, large and small intestines, heart, pericardium, pancreas, spleen, thyroid, suprarenal capsules, diaphragm, bone and subcutaneous cellular tissues.

#### DIAGNOSIS

The diagnosis of chorio epithelioma is often beset with great difficulties. One should always suspect it when profuse hemorrhage follows a hydatid mole that has been thoroughly removed. To be certain of this one must employ the procedure advocated by the writer some years ago, that is, in every case of hydatid molar pregnancy to perform a hysterectomy so that the hand may be employed to remove all the vesicles. Another inestimable value of this procedure consists in enabling the operator thoroughly to palpate every portion of the inner wall of the uterus for any suspicious nodule or extra thinning of the wall at any one place. In this manner the growth may often be detected in its very earliest stage, as was done by the writer in cases in his series and by Eden in one case.

For there can be no question judging from a close scrutiny of the reported cases that chorio epithelioma was not infrequently present while the hydatid mole was still in the uterus. It is safe to place in this category most of the cases of hydatid molar pregnancy in which the bleeding persisted or recurred shortly after the uterus was emptied. The case reported by Jellinghaus already referred to in the writer's opinion belongs to this class. If this assumption be correct then the advice given by Jellinghaus and others to subject every woman who has had a hydatid mole to a curettage every two or three weeks to determine whether she is developing a chorio epithelioma would obviously be unnecessary to say nothing of the dangers such a procedure would involve. H. Williamson makes the suggestion that the Aberhalden test be made every few weeks in every woman who has a hydatid mole so as to

determine the earliest development of chorio epithelioma. But it must also be borne in mind that in a few cases a period of amenorrhea intervenes between the removal or expulsion of a hydatid mole and the first symptoms of the presence of a growth. In Eden's case a period of two months and in Catarrus's case 3 months elapsed. No explanation has been offered for this paradoxical phenomenon. In Eden's case the growth was evidently present at the time of the hydatid mole as when he emptied the uterus he detected a small nodule on palpation and thought it was a fibroid nodule.

When the growth follows shortly after labor at full term the cervical canal is usually patulous. Then it may be feasible to palpate the interior of the uterus with the finger or fingers. The detection of an elevated fairly hard nodule with an excavation in the center is almost pathognomonic. The appearance of the characteristic bluish red papules on the vagina or in the vulva confirms the diagnosis. When the cervix is not patulous other means have to be employed which will receive attention later.

The greatest difficulties are encountered when the growth follows an early miscarriage for in these instances one can never be certain that the persistent bleeding may not be due to placental or decidual residue even though the curettage may have been done by an expert. In such a contingency one must have recourse to a microscopic examination which unfortunately even by the expert may not be conclusive or may even be misleading. Several cases are recorded in the literature in which the microscopic examination by a pathologist of repute and ability proved to be inconclusive or erroneous. The writer has already referred to an instance of his own in which a most capable pathologist made an error in diagnosis. When we stop to consider the nature of the condition we can readily understand how a microscopic examination may be attended with failure. Unless the curette scrapes away some of the deeper tissues the pathologist has no means of determining whether he is dealing with a new growth or with normal placental tissue. He can only determine this if the microscope

shows invasion of the deeper structures for that is the only distinguishing feature between normal chorionic tissue and chorioepithelioma. To add to the difficulties a curettage done so as to bring away some of the deeper tissues is not free from danger. It is prone to set free particles of the growth which may gain entrance into the venous circulation and then bring about rapid and extensive metastases. A close scrutiny of the case in the literature reveals the fact that the most rapidly fatal cases were those that were subjected to several curettages before a diagnosis was reached and a hysterectomy performed.

Hitschmann and Cristofolotti lay great stress upon the dangers attendant upon a curettage in chorio epithelioma. They studied 300 cases in the German literature and made a comparison between the cases subjected to a curettage and those that were not. In the former they found that metastases were very much more extensive and rapid than in the latter. They found also that the fatal non-operative cases had fewer metastases than those subjected to hysterectomy which terminated in death at an early date. Thus demonstrating that any manipulation of the affected tissues are likely to cause extensive metastases. In studying the reports of the cases in the literature one cannot fail to observe how much better the results were when the radical operation had not been preceded by two or three or more curettages as obtained in many of the cases. The unusually excellent results obtained by the writer in his series 8 recoveries in 9 cases cannot well be explained by the mere assumption that the cases were all of the semi benign variety. That would be a fortuitous occurrence not to be paralleled by a series of a similar number of cases in the literature. It is more within reason to attribute them to the circumstance that the diagnosis was made at an early stage of the disease than that in every instance the growth was of the non malignant type.

The only fatality in the series occurred in the case that was subjected to two curettages the pathological report of the first being misleading although a tentative diagnosis on the clinical evidences had already been made

by the writer. In spite of all these considerations instances will arise where recourse will have to be taken to a diagnostic curettage. The clinical evidence may not be conclusive it may justify only a suspicion and one would under these conditions naturally hesitate to remove the uterus in a young woman without having incontrovertible evidence of the presence of the disease. But if any aid in diagnosis is to be sought from the material obtained by a curettage one must make sure that the curette has brought away some of the deeper structures as already has been stated. Occasionally in a doubtful case especially in a young woman one might adopt the method employed by the writer in a case recently.

The patient aged 6 years had had a miscarriage of twins at about the third month 6 weeks before. She was curetted in a metropolitan hospital on the same day. She continued bleeding at times quite profusely. The uterus was but slightly enlarged she was now again curetted the pathologist reported that the tissues were suspicious of chorio epithelioma but he could not be certain of the diagnosis as there was no myometrium in the material. The bleeding recurred in a few days. Not wishing to subject the patient to another curettage the writer did a vaginal hysterotomy and also antverted the uterus through an anterior vaginal incision. In this way he was able to palpate and inspect with the naked eye both the inner and outer walls of the uterus. No growth or suspicious area was detected. The wound in the uterus was sutured the organ was replaced in the pelvic cavity and a suture applied to the vaginal wound. The patient has been under observation for over 3 months she has been perfectly well and menstruation has been normal.

The growth may be situated entirely in the uterine wall or projecting toward the peritoneal surface and has no connection whatever with the endometrium as in a case reported by H. Meyer and another by Nagy. Hence the necessity of exploring both surfaces of the uterus.

#### PROGNOSIS

There is no form of malignant new growth in which the prognosis varies so widely as in chorio epithelioma. If the diagnosis has been made early and the uterus has not been subjected to much manipulation as is occasioned by several curettages the prognosis is fairly



good. Different from other malignant growths the outcome may be good even in the face of extensive metastases. Several cases are on record in which there were evidences of metastases in the vagina and lungs and the patients recovered with and without operation. A remarkable instance of this kind is a case reported by J. C. Rockafellow<sup>1</sup> in which after removal of the uterus large growths recurred in the labia at intervals of a few weeks. As soon as the growths sometimes the size of a kidney were excised they would spring up again like mushrooms in a week or so. On the fourth recurrence the patient's general condition was so poor that it did not seem worth while to make any further attempt at removal. To the surprise of every one in a few weeks the growth spontaneously began to shrink and in a few weeks more had practically disappeared leaving a mere hard ridge at their site. The patient began to improve and in a short time regained good health and remained so as long as she was under observation which was a period of over two years.

Von Fleischman, Hormann, Hirschmann and Cristofolletti (loc cit) each report similar case. In Hirschmann and Cristofolletti case the operation was given up on account of the extent of the tumor which involved the vagina and bladder and extended far and wide in the pelvis. The patient improved rapidly after the operation and a month later there were no signs of the tumor of the uterus and the pelvic structure seemed to be free. The patient was in perfect health seven years later. In one of the writers' case (Case 4) several small bluish papules appeared on the posterior vaginal wall after the hysterectomy. These gradually disappeared spontaneously. Neumann<sup>4</sup>, Kelly and Teacher<sup>5</sup>, Marchand<sup>6</sup> have each observed spontaneous disappearance of vaginal metastases after removal of the uterus. Risel<sup>7</sup>, Liden and Lockyer<sup>7</sup> reported the observation of healed

nodules in the lungs among those still growing in a case which terminated fatally. Teacher himself publishes a similar observation.

Regarding operative results the statistics published by Teacher (loc cit p. 390) exhibit the most careful study. In the 189 cases collected radical operation was performed 100 times. Of the group not operated upon all ended fatally except the case of von Fleischman. Of the 100 cases operated upon 63 were followed by immediate recoveries and 37 by death of the 37 deaths 12 occurred within a few days evidently from shock and loss of blood. In the remaining 25 there was no marked improvement or interval of good health after the operation. Out of the 63 recoveries 3 were reported well six months or more after the operation and out of this number 4 remained well for more than a year and of the 13 again 13 were reported well more than two years after the operation. Among the fatal cases it was remarkable that in 5 only did the disease recur after a longer interval than six months and the longest interval between operation and death was one year. Death after a longer interval has since been reported. Teacher goes on to say: "Still one is justified in the conclusion that if the patient survive more than six months without signs of recurrence the probability of recovery being permanent is considerable after one year it is very great while cases in which two years have elapsed may be regarded as absolute recoveries."

Teacher draws attention to the striking fact that 42 of the cases with a percentage of recovery of 78 followed hydatid mole. He adds: "Possibly a considerable number of these should not have been described as chorio epithelioma malignum."

Briquet reported 114 cases with 7 operative recoveries and 4 deaths. Of the 181 cases collected by Follsson and Violet there were 16 operative recoveries and 17 deaths from operation. The difference in the operative recoveries in the two series could well be explained by the difference in the periods in which they were performed the one period extending from 1883 to 1903 the other from 1903 to 1912.

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Briquet analyzed this series in reference to the operative results following the different kinds of pregnancy. In 21 cases following labor at term there were 12 (57 per cent) recoveries in 34 cases following miscarriage there were 20 (58.5 per cent) recoveries in 54 cases following hydatid mole there were 37 (68.5 per cent) recoveries in 3 cases following tubal gestation there was 1 (33.3 per cent) recovery.

The writer is inclined to agree with Pollosson and Violet that the better results obtained in cases following hydatid mole are probably due to the circumstance that the cases are watched more closely and the diagnosis in consequence is made at an earlier stage.

Before taking up the treatment of chorio epithelioma it may be well to devote a short time to the consideration of the treatment of hydatid mole in view of the close connection between the two conditions. This close relationship between hydatid mole and chorio epithelioma was first established by Marchand in 1895. The frequency with which hydatid mole is followed by chorio epithelioma has been variously stated by different writers. Bumm in his textbook placed it at 15 per cent. Palmer Findley in a collection of 210 cases found it to be 16 per cent. On the other hand in 20 cases observed at the Kiel Klinik only two were followed by chorio epithelioma. Kehrer followed up the history of 50 cases of hydatid mole and did not meet with a single instance of this complication. The writer during a period of four years prior to 1911 had observed 8 cases of hydatid mole 3 of these were attended or followed by chorio epithelioma. Sennarclens (quoted by Pollosson and Violet) was enabled in the Canton of Vaud to observe for a long period of time 4 out of 49 cases 35 or 7 per cent were definitely cured by the expulsion or removal of the hydatid mole 7 or 14 per cent underwent immediate cure but the remote results were unknown. Three only or 6 per cent died from chorio epithelioma. It is obvious that statistics such as these furnish a more reliable basis as to the relationship between the two conditions than do those

coming from hospitals or operators. But granting even that the higher percentage expresses more closely the actual relationship it would scarcely warrant the attitude of some authorities that all cases of hydatid mole should at once be subjected to a panhysterectomy. When a hydatid mole occurs in a woman over 40 years of age as not infrequently is the case it may be the safer course to resort at once to hysterectomy rather than wait for the development of chorio epithelioma. But it occurs almost as often in young women ranging from 18 to 25 years in whom an unnecessary sacrifice of the generative organs would be most reprehensible. Hence in women let us say under 40 years of age the course advocated by the writer in a paper read before the New York Obstetric Society May 1911 ought to be followed. This as has already been described above consists in performing a vaginal anterior hysterotomy for the double purpose of making certain of removing all vesicles and of making a thorough exploration with the hand of the entire inner walls of the uterus. The woman should then be carefully observed for a long period and on the occurrence of profuse bleeding a diagnosis of chorio epithelioma would be justified.

The treatment of chorio epithelioma once the diagnosis has been made resolves itself into an immediate panhysterectomy for as we have already shown we have no means of determining whether the individual case be a highly malignant one or one that might undergo spontaneous cure. The latter contingency is so unusual that for all practical purposes it must be left out of consideration.

When the growth is discovered while emptying the uterus of a hydatid molar pregnancy the natural thing to do would be to complete the operation through the vaginal route. The same would apply when in a doubtful case an exploration of the inner and outer walls of the uterus would be made through a vaginal incision. In most all other instances the abdominal route probably is to be preferred for it embraces less traumatism and consequently less danger of causing metastases.

Hitschmann and Cristofolotti lay strong emphasis upon the selection of the abdominal route for this very reason and also because they deem it advisable to excise the deep pelvic veins as is done in puerperal thrombophlebitis. They assert that the pelvic veins are frequently filled with extensions from the growth. Hence the necessity of this excision. Should this even be the case it is doubtful whether the procedure is called for inasmuch as these venous extensions have a tendency to disappear spontaneously by clotting of the blood depriving the tumor masses of their source of nourishment. Vaginal nodules if present should be excised and if they occur subsequently the same procedure might be necessary although they also have a tendency to disappear spontaneously. Different from carcinoma the lymphatic vessels and glands are seldom involved and there is no indication for doing anything so radical as the Wertheim operation. One should not defer doing the operation in the face of the most unpromising local conditions for extensive infiltrations are usually due to venous involvement which as we have seen has a tendency to disappear spontaneously after removal of the uterus. Even when there are signs of metastases in the lung hydatidoma should not be denied if the patient be in a condition to withstand the shock of the operation for there are several cases on record in which the lung symptoms have disappeared after the original growth had been removed.

Radium has been employed in a few instances but with only temporary benefit.

CASE 1. Mr. L. P., a patient of Dr. Altman was seen by me January 4, 1906. She was 43 years old married 6 years. I had eight children the last seven years ago. Her marriage 16 years ago. She enjoyed good health and me true to had been normal until the present illness. Her last regular menstruation occurred September 2, 1906. On November 20 when her water lay low a bloody flow occurred resembling an intermittent duration her usual menses. But the blood continued to flow. She continued straining and days before I saw her she had a profuse flow lasting one day and I performed several large clots. She had no abdominal pain until the day of my visit when

referred it to the lower part of the abdomen and stated that it was moderately severe. Three weeks before while mounting a flight of stairs she felt a severe fluttering in the cardiac region and suffered from shortness of breath. She has suffered more or less from similar symptoms since then and complained of great edema. Swelling of the feet and legs as noted about this time and the swelling has kept on increasing until now. She had taken to bed the day before on account of general debility and the inability of the feet and legs. She was extremely anemic her breathing rapid and shallow pulse rapid and rather bounding. There was a soft blowing murmur accompanying the first sound and the cardiac impulse was diffuse. Cardiac dullness considerably increased. The abdomen as occupied by a spherical smooth tumor reaching to the upper border of the umbilicus. On bimanual examination the cervix was found soft and moderately patulous and passed into the abdominal tumor. The breasts were surrounded by a dark areola but no colostrum was found. The urine contained a large quantity of albumin and numerous granular hyaline casts. The diagnosis was made of a probable pregnancy of an abnormal type or a fibroid growth undergoing sarcomatous degeneration. The decision was given to have the patient enter Mt. Sinai Hospital and under anesthesia to explore the uterine cavity. This was done on January 9 and although only a few days elapsed since I had examined the patient the uterine tumor had markedly increased in size so that it reached midway between the umbilicus and the ensiform cartilage. As soon as I could introduce the index finger into the uterine cavity I felt distending the cervix and encountered a soft mushy material. I recognized it to be a hydatidiform degeneration of the ovary. I rapidly explored the uterus of its contents being certain that all the hydatid material was removed. The patient made a surprisingly good recovery. Her cardiac and pulmonary symptoms disappeared within a few days. The albumin in the urine rapidly disappeared and the casts gradually disappeared.

There was a light bloody flow for four or five days then a mucopurulent flow for four or five days longer and after that there was no discharge of any kind. The patient returned home and was gradually gaining weight and improving in color. When in February she was suddenly seized with a profuse uterine hemorrhage. I divided the attending physician to pack the vagina and to make immediate arrangements for the patient to be admitted to the hospital. Here two days later she was considerably engorged. In replacing the vaginal gauze there was a very severe hemorrhage. I rapidly stuffed some gauze into the uterine cavity and packed the vagina tightly. From the clinical history and in the enlarged history of the history of the patient I diagnosed chorion epithelioma malignant. On the following February 14 I performed a total abdominal panhysterectomy. I deem it

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safe to wait to curette and submit the scrapings to a microscopic examination. She made an uneventful recovery from the operation. Patient well up to the present.

**Pathological report** by Herbert L. Celler, Assistant Pathologist, Mt. Sinai Hospital (Specimen consists of uterus and adnexa). The uterus is very pale. Length of body 2.5 centimeters, width just below fundus 11 centimeters, length of cervix 4 centimeters. The organ is very firm, the serosa smooth. There is a slight lateral laceration on the right side of the posterior lip of the cervix. The walls of the fundus measure 3 centimeters in thickness at the widest part. The muscular tissue is intersected by numerous bands of connective tissue that coalesce near the mucus to form a more continuous broad band. The mucus lining both the body and cervix is smooth except at the internal os where there is a slight swelling and congestion and at the point of entrance of the fallopian tube. At the latter site there is a bean-shaped mass 1.5 centimeters in length projecting into the lumen of the organ. This tumor is mottled in color, red and white, soft and friable. The underlying muscular tissue is softer than that of the remainder of the uterus and is also friable. The hemorrhagic areas are however confined to the tumor itself and are not found in the underlying muscular tissue. The right ovary is normal in size. The left ovary contains two large cysts, one about 1.5, the other about 2 centimeters in diameter. Both fallopian tubes are negative.

Microscopically the tumor consists of both syncytial masses and Langhans cells. The former are arranged in plaques and in bands in some places forming a fine meshed reticulum. The spaces thus formed are frequently filled with red blood corpuscles or contain one or more cells of the syncytial or Langhans type. The former are irregularly shaped, deeply staining the outlines of the cell not always clearly defined. The nuclei are also irregular and stain with great intensity. Frequently these cells contain two, three or four nuclei. The Langhans cells stain faintly and have a sharply defined outline. The nuclei are round or oval and vesicular. The greater part of the tumor is composed of the above syncytial masses, but at one point there is a large mass of Langhans cells. Large hemorrhages are scattered throughout the tumor. At some points the syncytial cells lie close to the walls of blood vessels or lymph spaces, an occasional cell being present within the lumen itself. The tumor infiltrates the musculature of the uterus for about one third of its thickness. Scattered between the syncytial masses are numerous leucocytes, while surrounding the entire area of tumor tissue there is a marked round-celled infiltration. Between the tumor and the lumen of the uterus there is a thin band of necrotic tissue enclosing leucocytes and the remains of a few uterine glands. The wall of the blood vessels of the uterus have undergone hyaline degeneration.

Both ovaries show a number of corpora lutea in

which the lutein cells are proliferated. These bodies are small with the exception of one that lies in the midst of the dense tissue of the atrophic ovary. Here there is very marked proliferation of the lutein cell, many of which contain large granules of yellowish pigment. At the periphery of the corpus there are rather numerous distended blood vessels with thin walls. There are no evidences of organization present.

Diagnosis kindly verified by Dr. F. S. Mandelbaum, Pathologist.

**CASE 1.** G. H. admitted from the dispensary service into Mt. Sinai Hospital. She was 47 years of age, married 28 years, had nine children, last child eight years ago, two miscarriages, last one nine years ago. Menses had always been regular, moderate in amount, lasting from three to five days and not attended with pain. Seven days before her admission into the hospital she began to bleed. She was then two weeks overdue. The bleeding persisted and at times was quite profuse. She looked rather old for the age given and was moderately anæmic. Her general condition otherwise was good. On bimanual examination the uterus was found reaching to within two fingerbreadths of the umbilicus and was rather hard to the touch. There was a bluish discoloration of the vagina and milk could be expressed from the nipples. Dr. F. Krug confirmed the diagnosis of hydatid mole, which was made in my service in the dispensary. He curetted the patient himself, removing a large quantity of hydatid material. The patient made a good recovery and was discharged March 3 with the instruction to return if uterine bleeding recurred. At the time of her discharge the uterus was nearly normal in size. On March 8 she returned to the hospital with the statement that soon after she left the hospital the bleeding recurred and it has gradually been growing more profuse. The uterus was now found to be considerably enlarged, corresponding in size to the gravid organ at about the sixth week. A diagnosis of chorio epithelioma was made and on March 30 the uterus removed by *me per vaginam*.

April 8. The patient made an uneventful recovery and is sitting up out of bed. She was well two years later when last heard from.

**Report on specimen** by Dr. F. S. Mandelbaum, Pathologist to Mt. Sinai Hospital. The specimen consists of uterus and adnexa. The uterus is enlarged 11 x 9.5 x 5 centimeters. The wall measures 17-30 millimeters in thickness. Occupying the posterior wall and extending downward from the fundus for a distance of 48 millimeters there is a growth which fills up and slightly distends the uterine cavity. On either side the growth extends to the openings of the fallopian tubes, elevating the mucous membrane and causing it to slope downward to the opening. The tumor is sessile. Its edges are overhanging except at the upper half. The surface of the tumor is irregular and ulcerated.

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and microscopic section shows it to be chorion epithelioma malignum

CASE 3 Mrs C G admitted to Mt Sinai Hospital May 1912 She is 36 years old married 1 year 11 para last child  $4\frac{1}{2}$  years ago no miscarriages except this present one menses established at 14 years four weekly type duration 2 days Her last menses occurred 4 weeks ago 2 to week ago uterine bleeding set in which has persisted up to the present uterus the size of the gravid organ at 1 week

Uterus emptied by Dr I Krug The cervix was patulous admitting the insertion of the index finger with which the membranes were ruptured A small fetus and placenta were secured with placental forceps and the uterine mucosa thoroughly curetted with the sharp curette

May 14 Discharged from the hospital The following note was made at this time Uterus moderately enlarged and lying in retroversion

June 5 The patient as readmitted stating that for weeks she felt well and then began to bleed very profusely which was 5 days ago The bleeding has persisted until now The patient is quite anæmic Local findings about the cervix as when discharged 4 weeks ago The uterine bleeding is very profuse necessitating packing of the vagina

In view of the history and the certainty that none of the ovarian products are left behind by Dr Krug a diagnosis of chorioepithelioma was made

June 6 Abdominal panhysterectomy as performed by the writer The patient made an eventful recovery 1 year later in good health

Mac osopic report June 6 1912 The specimen consists of the uterus the left adnexa complete and the right tube The right tube in its distal half is thickened and tortuous The abdominal tumor is closed by adhesions The left tube in its distal half is also thickened and the uterine cavity much so as that of the other side The abdominal tumor is patent The left ovary is somewhat enlarged studded with small cysts up to size of pea The uterus is slightly enlarged In the left adnexa a small lobulated firm tumor attached to the uterine tube and invading the fallopian tube distance The tumor measures 2.4 centimeter and gravitates in the right The rest of the uterus and cervix is apparently normal *Miscroscopic diagnosis* Chorioepithelioma

CASE 4 Hydatid mole Chorioepithelioma Double ovarian cyst Hydatid cyst Myelopathy eclampsia Recurrent

Mrs S C a 35 year old married woman Dr J S D Mont She is 35 years old married fifteen months Menstruation fourteen years ago four weekly type Duration 2 to 3 days Last menses occurred 4 weeks ago

Six months after marriage went to California and then began to bleed irregularly with suppuration and miscarriage followed by a miscarriage followed by a miscarriage were regular after this for four months and then ceased for two months when she began to bleed irregularly at first scantily and later rather profusely

When she consulted me the bleeding had been going on for about two months

She was very pale, sallow and looked very ill The uterus reached up to the umbilicus and was rather tense The cervix was closed Behind the uterus lay two irregularly shaped cystic masses each about the size of a closed fist The urine contained a large amount of albumin and numerous hyaline and granular casts There was no edema The diagnosis was made of an abnormal pregnancy with double ovarian cysts

Operation November 2 Finding on attempt to empty the uterus that it contained a hydatid mole and as both ovaries were cystic I decided to perform a panhysterectomy which I did removing the cervix also The operation offered no unusual difficulties and consumed about an hour The patient felt good it very well At 3 o'clock the next morning twelve hours after the operation the patient was seized with severe convulsion lasting about ten minutes This was followed by coma of twenty minutes From this hour until 11 a.m. she had in all seven convulsions each followed by coma of longer or shorter duration The urine was very richly loaded with albumin and showed very numerous granular and hyaline casts Temperature had risen to 104 and pulse 160 very small and soft

The patient was subjected to the usual treatment for eclampsia in addition phlebotomy was done about 17 ounces of blood withdrawn and colon irrigations with saline solution were given She had gradual improvement to ward the evening of the same day when the temperature fell to normal although the pulse still remained very high (140 to 160) From this improvement as steady and on November 30 eight days after the operation the urine showed merely a trace of albumin

The removed uterus on microscopic examination showed quite an area of chorioepithelioma on the posterior wall near the fundus The ovaries were cystic throughout and the wall of the uterus was There was no excess of luteal cells December 1st not changed from the last time she was cured

January 5 1913 She was again referred to me by her physician on account of bleeding from the vagina I found a small ascarus in the center of the vaginal scar and dotted over the posterior wall of the vagina were small flat papules about the size of a pea and of a bluish red color I suspected a recurrence and had her readmitted to the hospital On January 19 I excised the growth with the Jacquelin cautery and also cauterized the papules on the vaginal wall The examination with the microscope showed no evidence of chorioepithelioma consisting only of connective tissue with blood cells I then left the hospital January 25

March 1st entered hospital at my request She was in good health her color had become good She gained weight There had been no recurrence of the bleeding The vaginal wound was healed and the patient is at a month and normal appears well Three years later I heard from her that she was well

*Macroscopical report* November 2 1910 The specimen consists of uterus measuring 13 centimeters from internal os to fundus. The wall measures 2.5 centimeters in thickness. The uterine mucosa is covered throughout by necrotic velvety tissue which is thrown up in places into markedly rugous and almost papillomatous masses. On section sinuses of uterus are markedly enlarged the cross section of the muscularis having a fenestrated appearance. Both ovaries are enlarged into irregular ovoid orange sized completely cystic masses with straw colored mucin like contents some of them containing blood.

*Microscopical diagnosis* (a) Chorio epithelioma (b) Polycystic degeneration of both ovaries. No marked proliferation of lutein cells (c) Hydatidiform mole

CASE 5 Chorio epithelioma Abdominal panhysterectomy Recovery

Mrs C B was admitted to Mount Sinai Hospital on March 1, 1911. She was 36 years old married at 18 years 7 children the youngest child being 3 months old. Menses at 14 years of age irregular three to four week period up to two years ago since then menorrhagia of 10 to 15 weeks at a time. The last regular period was 12 weeks ago bleeding since. For past 2 years she has had slight pain in the lower abdomen associated with backache and slight leucorrhœa.

Vaginal examination showed the uterus to be uniformly enlarged to size of 10 weeks pregnancy fairly soft the adnexa normal and the presence of a good sized rectocele and cystocele.

March 1. The patient had a rather profuse hæmorrhage from the uterus. She became pulseless and required very active stimulation. Hæmoglobin 64 per cent. Panhysterectomy by Dr Krug.

The specimen consists of a fibroid uterus about the size of a 3 months pregnancy. In the cavity there was a shaggy mass attached by a pedicle to the fundus resembling very much a piece of placenta which might be a necrotic submucous fibroid.

April 17 Patient was discharged in good condition.

*Macroscopical report* March 1 1911. The specimen consists of the uterus which is enlarged. The uterus shows marked hypertrophy of the wall which measures 5 centimeters. Near the fundus on the anterior wall is an area covered by soft granular and fungoid tissue which causes a thickening of from 1 to 4 millimeters in the endometrium. Besides this is tissue which appears to be amnion and chorion.

*Microscopical diagnosis* Chorio epithelioma.

CASE 6 A H was admitted to the Mount Sinai Hospital on June 12 1911. She was 33 years old married 15 years five children last child 21 months ago doubtful miscarriage 3 months ago. Menses at 14 years four weekly type duration 7 days. Three months before when menses were due she merely stunted. A month later stained again. At the recurrence of the next menses she flowed very profusely and suffered with pain in the right iliac region. She was then admitted to the Iying In Hospital

where she was curetted for a miscarriage. The flow persisted after the curettage and so did the pain. On admission the patient was found to be moderately anæmic. The uterus was about of normal size and the adnexa were apparently normal.

In view of the history of the case chorio epithelioma was suspected. Not desiring to subject the patient to another curettage it was decided to explore the uterus visually by an anterior colpotomy and if necessary by an anterior hysterotomy.

Operation June 15. A transverse incision was made in the anterior vaginal fornix and the uterus delivered through it. In the right cornu was seen a small vascular tumor the size of a filbert and presenting the characteristic bluish discoloration of a chorio epitheliomatous growth. The operation was completed by extirpating the uterus and adnexa through the vagina. The patient made a rapid recovery and was discharged on July 1. She was under observation for two years and remained perfectly well.

*Macroscopical report* June 15 1911. The specimen consists of the uterus with both tubes and ovaries. The uterus measures 15 x 5 x 3 centimeters. It is the normal multiparous shape. The cervix shows a shallow old laceration to the right. The wall of the uterus is 1.5 to 2 centimeters in thickness. A papilliferous mass is situated at the fundus in the neighborhood of the right horn. Its base is 1.7 centimeters wide and 2 centimeters long (from above downward) and the mass projects about 5 centimeters beyond the surface of the mucosa. The tumor is fairly firm and is pinkish brown in color. Both ovaries are of about normal size and cystic (old corpus luteum cysts). No recent corpus luteum of any prominence is visible.

*Microscopical diagnosis* Chorio epithelioma.

CASE 7 Chorio epithelioma Septicæmia streptococæmia Hysterectomy Death Mrs L L 31 years of age married 5 years had children one three and a half years ago and the second four months ago. She was seen in consultation by me March 18 1910 for persistent uterine bleeding. Her medical attendant an intelligent practitioner informed me that he had delivered the patient at term with instruments four months before. The patient went through a normal puerperium but the flow of blood in small quantities persisted for three weeks. It then ceased for three weeks when it recurred and continued off and on in slight amounts until two weeks before when rather a sharp hæmorrhage took place. He then curetted her removing apparently several fragments of placental tissue. This put a stop to the bleeding for some days when it recurred again slightly with rather a free flow now and then. On the night previous she had a profuse flow of blood. I found a strong healthy looking woman inclined to obesity with moderate pallor of the lips. She was nursing and the infant seemed to be thriving satisfactorily. On bimanual examination I found the uterus enlarged to the size of the gravid organ at about six weeks. The cervix

was pituitous admitting the index finger readily which on exploring the uterine cavity detected a sessile growth on the anterior surface of the uterus near the left horn corresponding in size to about a fifty cent silver coin raised above the surface about one fourth of an inch and presenting on its surface a hillock depression. There was no marked hardness of the growth. I made the diagnosis of a probable chorion epithelioma and stated that I could be more certain of the diagnosis had not a curettage been done a short time before. I argued that a placental residue the other alternative diagnosis could not prevent a criterion excavation on its surface. But here entered the element of doubt. Could not the excavation have been produced artificially by the curette. I advised therefore her entrance into Mount Sinai Hospital where the growth could be removed with the curette and subjected to microscopic examination. I curetted her that afternoon in the hospital without anesthesia in the presence of Dr. J. S. Mandelbaum the pathologist of the hospital. The curette removed so much tissue that it looked like ordinary placental tissue that both he and I thought that it was an ordinary case of bleeding from placental remains. The temperature rectal before curetting was 100.8 pulse 108. March 19 temperature 99 to 100.4 pulse 100 to 108. March 20 temperature 99.6 to 100 pulse 96 to 100 no bleeding.

Report from the pathologist stated that removed tissue showed nothing more than normal decidual structures. Being anxious to have the patient return to her nursing infant as soon as possible I had given orders to have her transferred home in the ambulance. On the following morning March 21 just as the patient was being gotten ready to be sent home she had a moderate flow of blood. She was taken into the examining room and the interior of the uterus gone over lightly with a curette in the supposition that a small fragment of tissue might have been left behind. The curette did not bring away enough tissue to account for the bleeding. She had scarcely been returned to her bed when she had a severe hemorrhage and she was at once brought back to the examining room and the uterus packed tightly with iodoform gauze. I no longer felt that we had in all probability done with a malignant growth notwithstanding the report from the laboratory and requested that a further examination be made of the tissue removed that morning. Four p.m. temperature 102 pulse 36. Assuming that the fever was due to the uterine packing the house surgeon removed two pieces of gauze from the vagina under the belief that on so doing he had removed all the gauze that had been employed in packing. March 24 and 8 a.m. temperature 99.4 pulse 116. Four p.m. temperature suddenly rose to 104 pulse 108 p.m. temperature 105.6 pulse 134. I had seen the patient in the morning when her temperature was normal and concluded that the temperature of the evening before was due to retention due to the uterine packing which was

relieved by removal of the gauze. In the evening her condition was reported to me and I immediately visited the patient. On specular examination I found that the house surgeon had removed only the vaginal packing and that the uterine gauze was still *in situ*. I removed it and irrigated the uterus with alcohol 50 per cent. March 23 8 a.m. temperature 103.6 pulse 140 vomited once. Blood culture taken. Decided to remove the uterus as soon as consent could be obtained. Eight p.m. temperature 103.8 pulse 148. Hysterectomy. Owing to the patient taking the anesthesia poorly and to the great abundance of fat in the abdominal wall and in the subperitoneal tissue of the pelvis it was not feasible to carry out ligation of the pelvic veins. Patient withstood the operation very well. March 24 8 a.m. twelve hours after operation temperature 103.2 pulse 140.

March 24 4 p.m. chill temperature 104 pulse 140 to 180. March 25 4 a.m. patient died.

Notes from the pathological laboratory. March 18 1910. Specimen of retained placenta received. Decidua with markedly atypical cells some very large with giant nuclei. Diagnosis is in doubt but it is suspicious of malignant change.

March 23 1910. Uterus received for examination. Ovary moderately enlarged and muscularis soft and flabby. Uterine measures 9 centimeters all considerably thickened 18 x 25 millimeters. Micro shows evidence of curettement. In the body anteriorly is a lenticular avid tumor occupying the site of the mucosa and the tissues immediately underneath infiltrate the muscularis for about 1 to 2 centimeters. On section this area measures  $3\frac{1}{2} \times 2$  centimeters and composed of soft hemorrhagic necrotic tissue. The microscopic sections of the uterine tumor show the so-called atypical variety (Marchand) of chorion epithelioma. In the superficial one there is extensive necrosis hemorrhage and conglomerate masses composed of atypical acidophilic syncytium and all of the Langerhans type in the deeper layers syncytial masses and chorionic wandering cells of bizarre shape penetrate the muscularis to a considerable distance and are all found free in the blood sinus. Diagnosis chorion epithelioma.

Autopsy performed on March 25 1910 at 2 p.m. by Dr. A. F. Lohr. Case of chorion epithelioma with pulmonary metastases. Body of an adult adipose female. Laminulus adiposus well developed. Operative incision in the median line above the symphysis pubis about 15 centimeters long.

The lungs are both glumous pinkish gray in color. Adhesions between lobes and between lung and pleurae. Scattered through right lung but more especially projecting along border are small tumor masses varying in diameter from 3 to 7 millimeters. On cut section they project sharply above the surface of the lung and are sharply circumscribed and have a port wine and somewhat reticulated appearance. The reticulum grayish. The dependent portions of the lung are

congested. There is no consolidation, no tubercles, no metastases. The bronchi are congested, the pulmonary arteries are normal. The left lung shows adhesions similar to the right except that there is no fibrinous exudate on surface. There are about twelve metastases of the shape and size described.

The heart is normal in size with marked fatty overgrowth. The pericardium is normal. The right auricle is somewhat dilated but not the right ventricle. There are marked changes over the coronary sinus; the muscle is flabby and pale. The tricuspid valve admits two fingers; the edges of the valve are retracted, thickened but show no recent lesion. The aorta shows fairly marked atheroma; the posterior much less than the anterior. Foramen ovale closed.

The liver shows slight parenchymatous and fatty degeneration, otherwise normal.

A slight perisplenitis is present but diffusely. The lymphatic structures of the spleen are not easily made out.

The kidneys show marked parenchymatous degeneration.

Floor of the pelvis is clean. There is some bluish discoloration along the line of suture. The vaginal veins show no abnormality. The inferior vena cava in its lower half shows no thrombosis.

*Microscopic examination.* There are metastases in the lung. The tumor mass itself is composed of large blood sinuses together with necrotic areas into which there has been hemorrhage. Scattered through the tumor but especially at the periphery there are groups of cells characterized by irregularity in size and shape. Nuclei for the most part are large and vary in their amount of chromatin; some of them are almost vacuolar and others show a dense network. The cell bodies where they can be observed are irregular in shape and finely granular. A number of cells show karyorrhexis. The cells are for the most part isolated, having only a slight tendency to form groups. A number are vacuolated. The diagnosis of chorio epithelioma is made.

*CASE 8.* R. W. aged 30. Married 26 years. Ten children. Last child eight years ago. Three miscarriages last seven years ago. Patient consulted me May 1911. She stated that her menses for the past year had been irregular, occurring from four to eight weeks. A month ago after a period of amenorrhea of eight weeks she began to bleed. The bleeding persisted with varying intensity up to the time of her coming. I found the uterus enlarged, had the sign of a gravid organ of about 12 weeks. It had a soft doughy feel. A diagnosis of hydatid mole was made and the patient given a card of admission to Har Moritz Hospital.

*May 1911 operation.* Vaginal hysterectomy. Uterus emptied of the kind of about a quart of characteristic fluid. Interior of uterus palpated. A suspicious nodule was felt in the posterior wall. Operation completed by doing a vaginal partial hysterectomy. Microscopic examination by the pathol-

ogist of the hospital confirmed diagnosis of chorio epithelioma which was also confirmed by Dr L. S. Mandelbaum, pathologist to Mt. Sinai Hospital. Patient in good condition up to the present seven years after the operation.

*CASE 9.* Mrs. J. S. admitted to the Mount Sinai Hospital on November 3, 1915. She was 44 years old, married for 26 years, had seven children, one dead, youngest child six years old, all pregnancies full term and normal delivery, one miscarriage. Menses began at 14 years, regular every month, duration from four to five days. Up to six weeks ago patient had amenorrhea for past five months. During this time she commenced to bleed and this has continued steadily and progressively up to the present time, much blood being lost.

Physical examination revealed the following. The abdomen was soft, relaxed, tympanitic. There was a mass present reaching almost to the umbilicus, hard and smooth in consistency, conforming to shape of a gravid uterus of four months advancement. The mucous membrane of the vaginal canal was of a violet hue. The uterus was large, ante flexed, conforming to size of pregnant uterus of almost four months. Adnexa were not felt. Cervix not patulous, direction down and forward.

November 5, 1915. Hysterotomy and emptying of uterus for hydatidiform mole performed by Dr S. Wiener. November 15, 1915. Uterus well invaginated. Hysterotomy wound slightly gaping at one point. November 16, 1915. Patient discharged in good condition.

*Pathological report.* November 10, 1915. Tissue from uterus, hydatid mole.

November 17, 1917. Patient readmitted. Diagnosis: chorio epithelioma. Vaginal flow daily for four months. (Through courtesy of Dr Joseph Brettnauer.)

Vaginal examination disclosed a moderate cystocele, cervix hard and nodular. Uterus anterior, slightly enlarged, fundus globular and hard. Both fornices clear. Uterine bleeding. Sound determines small, smooth, sound nodule on left lateral and anterior wall. Slight tear in perineum. Uterus slightly enlarged.

November 19, 1917. Exploratory curettage by Dr Lindeman. November 1, 1917. Cervix gauze removed. Patient's condition good. Extra systole more frequent otherwise no sign of cardiac lesions.

November 2, 1917. Vaginal hysterectomy for chorio epithelioma by Dr Lindeman.

*Specimen.* Uterus slightly enlarged. Normal tube and ovary. On opening the uterus there was present in the fundus a small (1 centimeter) friable, pedunculated tumor, dark brown in cross section and on surface, extending only a short distance into uterine tissue. November 19, 1917. Curetting shows evidence of malignant tumor, suspicious of chorio epithelioma. November 2, 1917. Uterus and adnexa show chorio epithelioma.

December 3, 1917. Patient discharged from hospital in good general condition.



# VAGINAL HYSTERECTOMY TECHNIQUE FOR THE CURE OF PROLAPSE OF THE UTERUS WHEN THE REMOVAL OF THE UTRUS IS NECESSITATED

WITH SPECIAL REFERENCE TO LAPPING OF THE VAGINAL FASCIA IN ALL FORMS OF VAGINAL PROLAPSE<sup>1</sup>

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A d g g W m H f l b t i n y k

In an article read by me before this society at its last meeting, describing a subtotal vaginal hysterectomy technique for the cure of procidentia uteri I reached the conclusions that (1) there was encountered in it an element of danger to life as the result probably of necrosis of the reconstructed uterine body which did not justify its further use (2) that the interposition of the reconstructed body added nothing to the result when success was obtained (3) that the essential feature in the success was the approximation of the cut surfaces of the cardinal ligaments and the correct readjustment of the fascial structure of the interior vaginal wall.

My object in this communication is to make a preliminary report of a vaginal hysterectomy technique for the cure of prolapse of the uterus where the removal of the uterus is necessitated and to advocate the principle of fascial lapping in all forms of vaginal prolapse. The initial step of the hysterectomy technique will be recognized as identical to that described in my previous study. The method of lapping the fascia described in the following sentence will be recognized as a plan of procedure suggested by me in the article referred to. Sometimes the interior vaginal wall like the uterus is considerably hypertrophied. When this is the case the mucosa can be removed in part from one lateral strip and the strips lapped so as to give additional strength.

It was not until December 11, 1917 and January 17, 1918 that there came under my care cases which conformed to the above description, namely, great hypertrophy of the uterus and vaginal wall and complete procidentia. A report of these cases and of the operation performed for their relief was

made before the New York Obstetrical Society February 1, 1918 and a description of the procedure which was followed will be published in the June issue of the *New York Journal of Obstetrics*.

## VAGINAL HYSTERECTOMY AND FASCIAL LAPPING FOR PROCIDENTIA UTERI

Two curved incisions meeting in front and behind are made about the cervix at its juncture with the vaginal mucosa. The vaginal tissue is separated from its cervical attachment and each cardinal ligament area of tissue covered from the cervix and penetrated and tied with a chromic gut suture No. 2. As the free end of these sutures are to be used at the completion of the operation forceps are now attached to each group.

The vesicofascial area may be entered by either a longitudinal incision or by the curved incision as they pass above and to the sides of the cervix. The preferable approach to this area of cellular tissue is through the curved incisions. When this area or line of cleavage between the bladder and fascia is found it is followed by blunt dissection on each side of the lateral limits of the anterior vaginal wall. The so-called vesico-uterine ligament which is but a part of the vesicovaginal fascia is next exposed and the bladder separated entirely from its fascial attachment starting below and working upward. As the freedom of the bladder from the fascia is continued toward the urethra the interior vaginal wall is incised in the median line until the blending of the fascia with the urethral tissue is reached.

The posterior surface of the bladder is now completely separated from the anterior wall of the cervix and the peritoneal reflection incised. The tissues between the cervix and

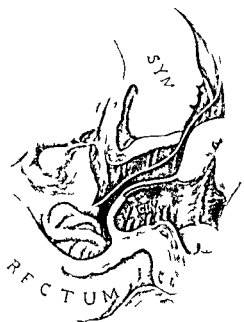


Fig. 1. Showing the uterus out of the pelvis with all its attachments secured except the posterior vaginal barrier. A high barrier with the gauze strip passed through the anterior opening, prevent the vaginal contents entering the peritoneal cavity.

the rectum are likewise separated but the posterior peritoneal reflection is not incised.

The corpus uteri is now delivered through the anterior peritoneal opening and a narrow strip of gauze to which is attached a piece of catgut is passed into the peritoneal cavity to protect it and prevent the intestines and omentum from protruding.

The vaginal flaps are next prepared for lapping by first trimming them longitudinally to not less than half their original size. From the right flap or that to the left of the operator the mucosa is completely removed. This flap is severed crosswise near its urethral attachment to the extent of about 0.5 centimeter so as to facilitate its adjustment when anchoring it under the opposite flap.

Four or more mattress sutures of chromic gut No. 1 are now inserted in such a manner as will anchor this denuded flap under the undenuded flap and to the opposite stable line where the fascia meets the lateral limit of the vagina. Four or more interrupted chromic gut sutures No. 1 and a continuous suture are used to anchor the undenuded flap

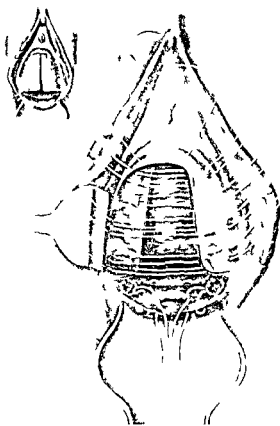
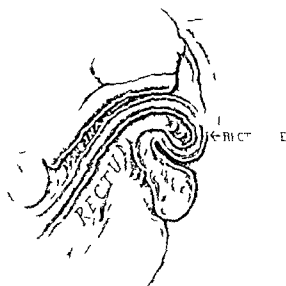


Fig. 2. The marginal insertion in the upper left hand corner shows the initial incision of the anterior vaginal wall with the opening in the vault of the vagina on the removal of the uterus. The dotted line indicates approximately the amount of tissue removed longitudinally from the flap.

The large illustration shows the underlapping flap denuded of its mucous membrane and the sutures placed for anchoring both flaps. A bundle of tissue is seen on each side of the vault of the vagina encircled by a chromic gut suture. One strand of each suture is passed in and out along the posterior vaginal cut surface to control hemorrhage and the other tied with it to approximate the lateral bundle or cardinal ligaments.

to the opposite stable line or lateral limit of the vagina and also to approximate the cut edges of the mucosa.

One strand of each chromic gut suture surrounding each so called cardinal ligament is utilized as a running suture along the posterior cut surface of the vaginal vault to prevent hemorrhage which not infrequently occurs from this surface. The remaining strands are now tied to approximate the cut cardinal ligament tissues. These latter sutures are used again and made to penetrate the lower margin of the newly constructed anterior vaginal wall from within out and tied to the sutures passed through the poste-



executed with greater care and exactness by attacking the upper portion of the broad ligaments first and working downward than by attacking the tissue around the cervix first (corpus remaining in peritoneal cavity) and working upward.

The third feature is the reinforcement of the anterior vaginal wall by lifting the fascia and anchoring the cut margins to the table area of the vaginal canal and approximating the cut surface of the cardinal ligaments.

That prolapse of the uterus as well as of the anterior vaginal wall has been cured by varied surgical procedures is not to be questioned but failure continues to occur and no method has yet established itself in the confidence of the majority of surgeons.

When success is attained by any of the methods previously mentioned in vaginal emphasis is placed upon some particular feature considered essential for success.

When hysterectomy is done for the relief of proidentia emphasis is laid upon the approximation of the cut edges of the round and broad ligament in one method or the shortening of the uterine ligament or the anchoring.

If the round ligaments in the vault of the vagina in either the interposition of the approximated round and broad ligaments or of the recto uterine corpus uteri in still others.

In my opinion all these special features are given undue consideration and success when attained is the result not of them but of a common element entering into all of them—namely, surgical adjustment of the pelvis.

It is not my object to discuss the individual operation for the cure of proidentia uteri and to state that it would seem fitting because of its historic interest and the principle involved in the Emmet operation to do more than make passing mention of it.

Emmet utilized the principle of fascial support of the anterior and lateral vaginal wall with the intuition and skill of the consummate surgeon. He recognized that success depended upon the unyielding line along the vaginal wall on each side where the wall are connected with the pelvic fascia—and that this tissue owing to its elasticity can be stretched to a certain degree

of the vaginal wall. Before turning the cervix up the first feature is the removal of the broad ligament and the posterior vaginal wall and the removal of the broad ligament in the vagina complete the operation.

The feature which I would particularly emphasize in this technique are (1) the separation of the bladder tissue at the beginning of the operation from the posterior surface of the cervix up to the peritoneal reflection with uterine incision. Douglas's cul-de-sac. The great advantage of not entering the peritoneal cavity at the beginning of the operation is that the continuity of tissue here acts as a barrier to prevent the content of the vagina from filling the peritoneal cavity and the intestine from protruding into the vagina. It also prevents the cervix uteri from coming in contact with the peritoneum when the fundus is reinserted and the cervix is forced back into the vagina.

The second feature pertains to the removal of the corpus which is delivered through the anterior peritoneal opening and operated on at the vulva. Each step in its removal is

performed in a certain order and in a certain manner.

but for all practical purposes the areas are fixed.<sup>1</sup> By Emmet's method two lateral fascial surfaces are united to a central fascial surface in this way the fascial support of the uterus and bladder is reconstructed and we have here the first instance on a limited scale of fascial lapping of the anterior vaginal wall. In Emmet's hands success by this method was the rule. In the hands of others success seems to have been the exception. I would not refer to this operation long since considered obsolete by many were I not convinced that it possesses an essential feature of success. Grant Baldwin recognized this fact several years ago and also the cause of failure in the original technique and modified it with such results as should demand our respectful consideration.

It would seem a justifiable conclusion with the evidence at hand that the underlying principle of success in operations for the cure of uterine and vaginal prolapse is the proper surgical adjustment of the pelvic fascia but the fact remains that we have not yet developed a standard technique or one which can be applied with such modifications as the necessity of the individual case demands to meet all requirements.

When a prolapsed uterus has undergone such structural change a necessitates its removal or when after menopause its removal is considered for one reason or another desirable the vaginal hysterectomy technique as herein described will prove I believe the method most adaptable and satisfactory. I recognize that it has not yet been put to the test of time but as it is in principle identical to that upon which nature under normal conditions depends for support confidence in its ultimate success would seem justified.

#### CERVIX AMPUTATED CORPUS RETAINED AND VASCIA LAPPED

When it is found advisable in cases of procidentia uteri to retain the uterine body but amputate the cervix the following technique presents certain advantages.

The first stages of the technique are in principle identical to the first stages of the vaginal

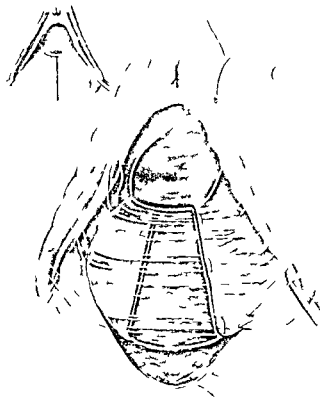
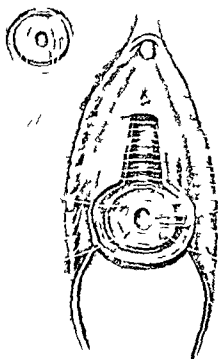


Fig. 4 The dotted lines in the margin represent the approximate amount of tissue removed longitudinally from each anterior vaginal wall flap. The drawing shows that mislabeled the amount of tissue removed is really more than could seem from the drawing. The tendency is to undercorrect by not removing enough tissue. The appearance after operation should be that of a correction.

The figure illustrates how the underlying flap is denuded of its mucous membrane, the line of incision is in line with the perineal body, the lined perineal body and all sutures placed for and original flap and clonically.

hysterectomy technique previously described that is the vesicofascial area near the cervix may be entered by either the longitudinal or curved incisions. The line of cleavage is then followed laterally to the side walls of the vagina longitudinally to the urethral region and along the cervix to the peritoneal area. As the separation of the bladder from the fascia progresses the anterior vaginal wall is incised in the median line up to the urethral region. The vaginal wall flaps are now trimmed longitudinally to the extent required and the flap to the left of the operator denuded of its mucous membrane. The sutures anchoring the flap are placed in the manner described in the vaginal hysterectomy technique for



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procidentia uteri namely four or more mattress suture being used to anchor the denuded or underlapping flap to the opposite stable line of the lateral wall of the vagina and four or more interrupted chromic gut sutures and a continuous suture to anchor the undenuded or overlapping flap to the opposite stable line of the lateral wall of the vagina.

Previous to tying the sutures of the anterior vaginal wall the mucosa about the cervix is stripped back laterally and posteriorly sufficiently to permit of a high amputation

of the cervix. The sutures of the cervix are placed according to a plan which is here particularly adaptable and serviceable. One figure of 8 suture is inserted through the upper area of the cut surface of the cervical stump and one through the lower area. These two sutures may be placed immediately after the amputation of the cervix and used as tractors controlling hemorrhage at the same time. At the completion of the operation their free ends are passed through the edges of the freed vaginal mucosa and when tied they approximate the mucosa over the stump. The sutures which direct and secure the vaginal mucosa to the cervical canal are inserted in an opposite direction to the classical method of Emmet. The needle is first inserted into the more or less free lateral tissue or cardinal ligaments on each side. The free ends of each of these sutures are passed through the cervical stump near the canal and back through the margin of the freed vaginal mucosa of the same side. By this form of stitching two objects are attained namely the cardinal ligaments are anchored to the cut surface of the cervical stump and the vaginal mucosa is anchored to the cervical canal. Extra sutures may be inserted if necessary and finally a narrow strip of iodoform gauze is passed through the cervical canal into the cavity of the uterus to prevent a possible union of the cut edges of the mucosa in the region of the cervical canal. Perineorrhaphy is done if required and the vaginal canal is packed moderately tight with iodoform gauze. By the Emmet technique the tissues of the vesical area are used to cover the anterior surface of the cervical stump and to that extent the anterior wall is shortened. If his method is reversed according to the plan just described the length of the anterior wall is not shortened.

When in the childbearing period prolapse of the uterus and bladder is corrected by fascial lapping and the uterus retained it is as yet an open question whether or not the reconstructed fascial wall would prevent or in any way interfere with the process of labor. I have not as yet operated for procidentia uteri or cystocele by the fascial lapping method and preserved the entire uterus.

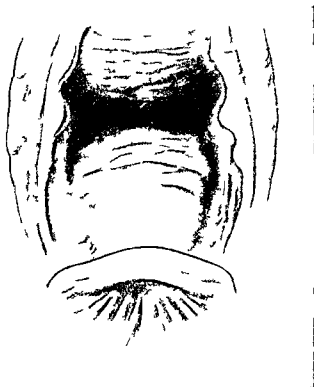


Fig 6 This illustration shows a partial rectocele with deep vaginal sulci and a complete laceration of the sphincter. The black line indicates the first incision made in performing the Rittz operation. The repair of the sphincter and correction of the rectocele were done at the same time.

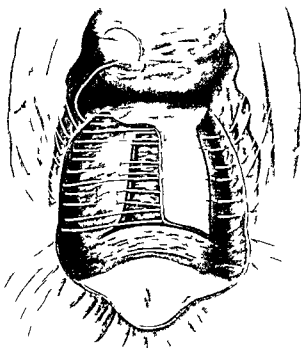


Fig 7 In this instance we had two deep sulci to care for. The posterior vaginal flaps were prepared in the way previously described except that the flap to the right of the operator was not trimmed longitudinally and that portion of it which extended down in the sulci was denuded of its mucosa as was its corresponding lateral vaginal wall. The sutures were then placed in the manner shown in the drawings. When these sutures were tied the flaps were anchored in such a way as to obliterate the sulci and elevate the posterior vaginal wall.

The Emmet-Baldwin operation does not permit of the completion of labor without the destruction of the operative results.

With complete procidentia uteri both the anterior and posterior vaginal walls prolapse in greater part while this is the rule cases do occur where one wall protrudes from the vulva more than the other so that in one case we may have a marked cystocele with the posterior wall but little affected and in the other case a marked rectocele with but little protrusion of the anterior wall. Protrusion of one or another vaginal wall accompanying procidentia uteri does not however necessarily constitute rectocele or cystocele but such a situation indicates a more or less damaged structural condition of the walls and demands surgical repair.

True cystocele is a more common accompaniment of procidentia uteri than rectocele. Either may exist independent of procidentia but if associated with procidentia they precede and do not follow. A cystocele therefore may exist with the cervix in normal

position likewise a rectocele may exist with the cervix in normal position. The case of Mrs. D. which I reported in my last communication on this subject was a striking example of the first type and the first case of rectocele to be here reported a description of which constitutes the basis of my work on fascial lapping for the cure of rectocele is an example of the second type.

#### FASCIAL LAPPING FOR RECTOCELE

The mucous membrane of the perineum is first removed and the rectovaginal fascia exposed. This fascia is incised at about where it merges with the perineum or its remaining structures. On incising the fascia a cellular area is entered which area constitutes the line of demarcation between the rectum and the vagina. The cellular tissue encountered is now separated from the under

surface of the fascia laterally to the border of the levator ani and longitudinally to the region of the cervix. A the facing of the tissue from the fascia is continued in the direction of the cervix a median longitudinal incision is made and extended as far as necessary.

The vaginal flap is now prepared for flapping by first trimming them longitudinally to an apparently excessive degree. The extent of this trimming depends on the amount of redundant tissue or size of rectocele. Pouching picking only about half of each flap remain and the effect produced after completion the operation is that of vertical resection.

The flap to the left of the cervix is now carefully denuded of its mucous membrane. Scissors are used to make the denudation by careful use of the matheson ulmus ulnar type of scissors left up on the fascia which covers it maintaining the cord continuity of the flap. The flap thus remaining is relatively thick and is set at the point of the future better than the fascial new wall.

The denuded flap is now rolled so wide at its highest point that the extent of about a centimeter in order to make a better fascial approximation when the flap is lifted.

The former matter of the perineum is brought down and the denuded flap is placed on the line which marks the future of the lateral limit of the vagina. The former matter is ruptured and the uterine and vaginal flaps are united in the undenuded flap. The opposite unruptured line of the flap will be the vagina.

When the rectovaginal flap is in place the perineal matter is fixed.

With rectocele a with a cycle we have a demarcation in part in which the fascial support. When the ligaments are extensive in the limit of the perineal or surgical approximation of the perineal junction of the levator ani muscle constitute a sufficient barrier but when an extensive rectocele exists which may have the entire posterior wall or when the fascia has been torn away from each lateral wall a in the second case to be careful fascial flapping to the

extent of the rectocele can alone be depended upon.

A rectocele may have associated with it twin complications and the operative technique used must be modified accordingly as illustrated in the following case. Laceration of the perineal body through the sphincter an extensive lateral tears of the posterior vaginal wall forming a sulcus on each side 4 centimeter or more in length and centimeters in depth. The rectovaginal fascia was here torn away from the lateral wall and the posterior or rectovaginal wall bulged out like a tumor protruding from the vulva.

A crescentic incision was first made over the triangular area according to Pistone and the flap of tissue dissected down to the rectum and the skin border. The protruding pouch was next incised immediately above the crescentic incision and the rectovaginal cellular area entered. The line of cleavage from this point was followed laterally to the mid wall and longitudinally beyond the limit of the pouch. A longitudinal incision was now made in the middle of the posterior wall extending half its length. The flap was trimmed longitudinally and the mucosa was completely removed from the ulcer and the flap to the left of the perineum. The mucosa of the ulcer to the right of the perineum was removed but the mucosa of the vaginal flap from the left was not removed. Several matter of the ureters were incised which when tied approximated the denuded surface of the ulcer to the right and anchored the denuded flap to the right where the incision finally meets the lateral limit of the vagina. The remaining the undenuded flap was anchored to the opposite tubular incision the line will be the vagina. The mucous membrane of the ureters was united with a continuous catgut suture by plan of the ureters. No O'Connell catheter was placed in the phantasmal to approximate and accurately adjust the edges. Silver wire sutures were placed in the perineum in the usual manner and penetrator the incision of the muscle. The result of the operation was not only a complete retraction of the sphincter and the perineal body but a resection of the

rectocele and an elevation of the entire posterior vaginal wall to practically its normal position. Hysterectomy had previously been performed for procidentia according to the method herein described a report of which operation will be found in the *New York Journal of Obstetrics* June 1917.

It was found necessary in the first case of rectocele here reported to keep a depressor in the space created by the separation of the rectum from the vagina in order to prevent the fat deposited in the cellular tissue from interfering with the proper adjustment and anchorage of the denuded flap when the sutures were tied.

Fascial lapping meets its ideal application in extensive rectocele and cystocele. When applying this principle to these conditions the several fascial areas which have been given special names have as such no particular value. When cystocele is present a greater portion of the bladder is enveloped by the overstretched anterior vaginal fascia than normally exists. The same is true of the rectum when rectocele exists and the surgical problem here presented is to restore the normal relationship of the viscera and fascia and reinforce the supporting structure so as to form an effective barrier and support.

The most satisfactory approach to the line of cleavage between the bladder and the fascia is at the angle formed by the cervix and the anterior vaginal wall. As the incisions sweep around the cervix from above they should be made to cut through both the mucosa and the fascia. The line of cleavage entered here is followed laterally to the limit

of the vagina and then longitudinally to the region of the urethra. The longitudinal incision of the anterior wall is started in the median line below and continued upward as the bladder is separated from the under surface of the fascia.

When the vesicofascial line of cleavage is sought entirely through a longitudinal incision of the anterior vaginal wall it not infrequently happens that the line of cleavage between the mucosa and the fascia is mistaken for the line of cleavage between the fascia and the bladder and as a result the fascia is considerably injured in the effort to define and free the bladder. One of the great advantages of the fascial lapping technique here described whether dealing with a cystocele or rectocele is that the finding and following of only one line of fascial cleavage is necessary. When this line of cleavage only is followed a minimum amount of bleeding results but when both lines of fascial cleavage are followed a maximum amount of bleeding occurs which under certain conditions may terminate seriously. Another important advantage in thus utilizing the fascia without disturbing its continuity is that a minimum amount of disturbance in its circulation is occasioned and when the flaps are anchored the circulation in them remains practically unimpaired.

Too much emphasis cannot be laid on the desirability of trimming the vaginal flaps to apparently an excessive degree. Failure will occur if the effect produced after the completion of the operation is not that of over correction.



THE EFFECT OF HYSTERECTOMY UPON OVARIAN FUNCTION<sup>1</sup>

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F m h (y e) l g l D p m t f t h J b H p k l r s t y d w p l

THE purpose of this communication is to present an analysis and impartial estimate of the existing evidence for and against retention of ovarian tissue after hysterectomy. Such a study seems both timely and desirable for two reasons: (1) because our knowledge of ovarian function has been substantially increased during recent years (chiefly through the intensive study of endocrinology) and (2) because there has arisen a sharp division of opinion among those most competent to decide this matter. One group is persistently advocating the routine conservation of healthy ovaries after hysterectomy while a minority is vigorously condemning the practice as scientifically without justification. From a review of this interesting controversy, it very soon becomes apparent that at least some of the conflicting opinions and a good deal of confusion has come about from failure fully to appreciate the scope and complexity of the problem involved. To avoid this it is absolutely essential to begin our study with a comprehensive and clear conception of whatever knowledge we have of the normal physiology of the ovaries. With this as a criterion we may then safely proceed to inquire from anatomical and histological data from experimental research from observations based upon pathological physiology and from the evidence furnished by clinical statistics in what respects and to what degree total ablation on the one hand or conservation of ovarian tissue on the other alters our physiological composite.

## THE FUNCTIONS OF THE OVARY

In the light of recent investigations and from a biological point of view the only conception of the ovary which is tenable today is that it is a complex glandular organ possessing fundamentally a dual function. One of the relates to the phenomena of

reproduction of the species while the other is concerned primarily with the elaboration of one or more specific internal secretion. Let us examine the evidence upon which this conception is based.

*Constituents of the normal human ovary.* For the present we will omit a discussion of the stroma the intrinsic nerves the lymphatics and the blood vessels confining our attention to a consideration of the epithelial elements. These consist primarily of varying numbers of graafian follicles with their contained ova. Secondly and originating from these are the corpora lutea degenerated or atresic follicles and possibly also at least during pregnancy the so called interstitial glands.

The ovum appears to possess at least a twofold function. Meyer has shown that from the earliest development on to atresia the life of the follicle (epithelium) depends upon the vitality of the ovum; that the formation and development of the corpus luteum depends upon the maturation and expulsion of the ovum and that if fertilization occurs the ovum operates to prolong the life of the corpus luteum. In addition to this fundamental influence upon ovarian elements the ovum possesses the all important function of reproduction of the species which process begins only after fertilization with the male element. In conflict with this generalization however are to be mentioned the observations of Loeb that the unfertilized ovum of the guinea pig may undergo limited development even to the formation of the anlage of the central nervous system while still in the follicle. But this is not of uniform occurrence and furthermore such ova subsequently degenerate.

The corpus luteum is the most conspicuous element of the ovary. Its morphology and development from the collapsed follicle following rupture and expulsion of the

ovum have been exhaustively studied and repeatedly described by a number of investigators and need not be repeated here. The various phases of its life cycle are now universally agreed upon with one important exception which has been made the subject of much study and of prolonged discussion—namely, the origin of the lutein cells whether they arise from the theca interna and are therefore of connective tissue origin or whether they develop from the cells of the membrana granulosa and hence are epithelial in nature. Both views have been ably championed. But particular mention should be made of the work of Sobotta and of Sandes on the lower animals and of the recent studies of Robert Meyer and of Novak on the very early stages of the human corpus luteum because collectively these investigations appear to establish conclusively the correctness of the epithelial theory. Additional evidence too in support of this view is to be found in the pointed observation of Frank that from a physiological standpoint the corpus luteum behaves like an epithelial structure and that the entire organism furnishes no example of a gland with either internal or external secretory function which develops solely from mesodermal structures. In connection with the morphology of the corpus luteum it is important to emphasize two other facts which have been established through these intimate histological studies. One is that the corpus luteum undergoes constant change from day to day in its structure and appearance first progressive and later regressive in character indicating of course functional activity, the other is the remarkable prolongation of the life of the corpus luteum during pregnancy.

A third epithelial structure in the ovary which demands consideration is the atresic follicle. Relatively few follicles go on to full maturity, rupture, expel the ovum and terminate in corpora lutea. The vast majority of them undergo varying degrees of development usually approaching maturity followed by gradual disintegration of the ovum and granulosa cells. Coincidentally the cells of the theca interna enlarge, become

epithelioid in appearance and persist for a considerable time in many species of animals (about 50 per cent of eighty species carefully investigated by Fraenkel) but in woman this occurs only during pregnancy. These are the so called interstitial glands.

Since numerically at least atresic follicles constitute the most important epithelial element in the ovary and further since they appear to play no part either in menstruation or in reproduction our ignorance regarding their function furnishes a strong argument for ovarian retention after hysterectomy.

Concerning the function of the other epithelial constituents of the ovary we are now in possession of considerable knowledge thanks to the studies and experimental researches notably of Loeb, Fraenkel, Ancel and Bouin, Frank, Marshall, Heape, Hirschmann and Adler, Robert Meyer, Ruge, Schroeder and others. Thus it has been shown that cyclical changes occur with methodical regularity both in the ovaries and in the uterus and further that a definite correlation undoubtedly exists between these respective phenomena. In the ovaries there occurs in orderly sequence (1) follicle ripening, (2) ovulation and (3) corpus luteum formation. Coordinated with and dependent upon these ovarian changes there occurs in the mucous membrane lining of the uterus an equally interesting and orderly cycle consisting of (1) premenstrual hypertrophy and hyperplasia, (2) menstruation and (3) regressive changes followed by a period of inactivity or rest. The evidence appears to be conclusive that these changes in the endometrium are brought about through the specific action of a chemical substance furnished by the corpus luteum. This remarkable structure furthermore has been definitely shown to inhibit ovulation and by so doing it prolongs the sex cycle in lower animals. During pregnancy the life of the corpus luteum is greatly prolonged and it has been shown to be essential to the early part of pregnancy since it has a sensitizing action on the uterine mucosa without which the ovum is unable to implant itself thereon. In all mammals there is a

striking coincidence between follicle ripening and the period of heat which strongly suggests a stimulation of the sexual mechanism by a specific secretory product.

In addition to these important cyclical phenomena which are concerned primarily with reproduction the ovary is known to possess other functions of prime importance. Thus the normal growth and development of the generative tract together with that of the whole group of secondary sexual characteristics occurring at puberty are known to depend largely upon trophic influences of the ovary. Likewise we know that it not only controls the development of the mammary glands but is responsible also for the cyclic changes which they manifest. Furthermore abundant evidence both experimental and clinical is available to establish incontrovertibly the intimate and vital connection of the ovaries with other units of the endocrine system. Particularly is this true of the pituitary gland, the thyroid gland and the adrenal glands. Recent reviews of the studies supporting this assertion have been published respectively by Coetsch by Marine and by Vincent. Less convincing but highly suggestive are the observations pointing to a possible functional interrelationship between the ovaries and both the parathyroid and pineal gland. The same is true of the possible part played by the ovaries in the general metabolism of the body. Certainly no one can at present deny the possibility at least of the participation of ovarian influence in these several directions also. Finally the equilibrium of the nervous system in the human female both in the psychic domain and particularly in that of the autonomic constituent appears to depend exquisitely upon the integrity of the ovaries.

Many interesting and valuable data have been purposely omitted from this brief summary but we may safely accept what has been said as supplying the physiological composite of ovarian function necessary for the purposes of this study. It strikingly emphasizes at least two facts—namely that the ovary is a vitally important biological unit which is constantly playing an

important role in the body economy and that its influences are unmistakably discernible far afield from the domain of the reproductive system of which it constitutes so important a part. No more conclusive clinical demonstration of the far reaching influence of ovarian activity could be reasonably desired than that furnished by the phenomena occurring with menstruation and with the physiological as well as the artificial or surgical menopause.

A careful comparison of the symptomatology associated with these three conditions reveals the surprising fact that they differ from each other chiefly in degree and rate of development. This fact does not appear to be generally recognized. On the contrary the numerous reference to these varied symptoms encountered in the literature leaves one impressed with the chaotic and confused state of mind which now exists regarding them. There is manifest need of a scientific classification of these vexing phenomena and in hopes that an effort in this direction may stimulate discussion and eventually lead to a satisfactory coordination of them. I have undertaken from authoritative sources first to tabulate and then to classify them. It seems rational to divide them into two great groups: (1) those which arise within the domain of the autonomic nervous system and (2) those originating in part from activation or sensitization of the spinal reflex arc and in part from the higher cortical cells of the brain which collectively constitute the psychic domain.

#### I. Symptoms from the domain of the autonomic nervous system

- 1 Vasomotor—Hot flushes, headaches, dizziness, vertigo, fainting, dermatographia, urticaria, erythematous hands and feet.
- 2 Cardiac—Palpitation, tachycardia (mild with normal heart).
- 3 Gastrointestinal (motor and secretory)—Digestive disturbances with flatulence, eructation, nausea and occasional vomiting, stasis, meteorism, constipation, diarrhoea.
- 4 Urinary—Irritable bladder, polyuria.

- 5 Endocrine—Thyroid hyper and hypofunction pituitary—e.g. obesity adrenals—e.g. hypotension gonads—e.g. changes in libido sexual voluptas and secondary sexual characteristics—e.g. voice body conformation countenance facial hair breasts and external genitalia
  - 6 Sweet glands—e.g. sudden sweating
- II Psycho Neurotic Symptoms
- 1 Psychic—Fatigability mental and physical emotivity hypersensitivity irritability changed temperament anxiety and apprehension in somnia excitability hysteria psychoses depression apathy and indifference lack of energy impaired memory aphasia indecision self condemnation suicidal ideas
  - 2 Neurotic—Exaggerated reflexes tremors and epigastric quivering visual and auditory disturbances lowered muscle tonus paresthesia

This classification is merely tentative. It seems to me however to be rational simple and reasonably comprehensive since it certainly embraces most of the disturbances associated with menstruation and the menopause whether normal or artificial. It is incorporated in this study to help emphasize the close relationship which exists between the clinical syndromes of these epochs in a woman's life and to accentuate further the scope and complexity of ovarian influence.

We are now in a position to inquire in what respects and to what degree ovarian function as detailed above is impaired or disturbed by surgical removal of the uterus.

*Anatomical and histological data* From this source we will first inquire whether an adequate arterial and venous circulation of the ovary is assured by the technique commonly employed in the surgical removal of the uterus particularly when the operation includes removal of the fallopian tubes. The studies on this point of Keitler Werth Olshausen Polak and particularly of Sampson show that the blood supply to the ovary from the uterine artery and the drainage from the ovary through the uterine veins

is cut off in doing hysterectomy that the danger to the ovarian circulation is greatly increased through salpingectomy and finally that failure to recognize these anatomical points is responsible for a large percentage of degenerated ovaries following these operations. I feel that this last point should be stressed because I am convinced that many of us have jeopardized the function of a conserved ovary through unnecessary surgical damage to its circulation.

We next wish to know from the data under consideration what has been learned from subsequent gross and microscopic examination of human ovaries regarding their ultimate fate after hysterectomy. Unfortunately the available information on this point is meager and one must be extremely cautious about drawing conclusions from it. Vineberg in 1915 was able to glean from the literature and through personal communications reports of only 28 cases of second operations for disease of retained ovaries. In the majority of these the primary operation had been of such a capital nature as to make it highly probable that the ovarian circulation was subjected to unusual traumatism and at least four of them were associated with malignant disease of the uterus. Graves reported two cases of cystic degeneration and one of papillary cystadenoma found at second operation upon retained ovaries. He adds that he has frequently removed ovaries which had been retained at a previous hysterectomy and in every instance found them densely adherent degenerated and cystic. On the other hand Vineberg removed one of two normal looking ovaries sixteen months after abdominal hysterectomy and found it normal microscopically. Grammatikaki examined the ovaries of a woman who died three years after a panhysterectomy for cancer and not only found no evidence of degeneration but observed follicles in all stages of development. Glavecke observed two cases six months after hysterectomy and found the ovaries normal in both of them. Weber studies fifteen ovaries obtained long after the menopause and found in four of them follicles in various stages of development and in one instance a corpus luteum.

The inference from this evidence is that the uterus is not essential to a continuation of ovarian function and that when ovarian degeneration follows hysterectomy it is to be attributed either to associated ovarian disease or to damaged ovarian circulation or to both of these factors

*Experimental data* Grammatikatis was the first to study experimentally the effect of hysterectomy upon the ovaries. He used rabbits for this purpose and found after an interval of three or four months that microscopic examination of the ovaries showed them to be normal in every detail. Mandl and Buerger incorporated in the most comprehensive monograph that has been published on this subject the results of a much more elaborate experimental study made upon rabbits and ape in which an interval of eight months to three years was allowed to elapse between the removal of the uterus and the subsequent examination of the ovaries. They were able to detect only slight evidence of congestion which they thought possibly interfered lightly with the function of the organ.

Similar results were obtained in experiments by Burckhardt and by Keitler. Martin concluded from his excellent reviews of the voluminous literature on ovarian transplantation that autotransplantation of ovarian tissue retard and modifies the symptoms of the artificial menopause precipitated by castration in a definite number of cases depending undoubtedly upon the graft retaining its vitality. So that the available experimental evidence completely demolishes the theory of an essential physiological interrelationship between the uterus and the ovaries and demonstrates conclusively that ovarian function in part at least proceed uninterruptedly after hysterectomy.

*The data from clinical studies* Since 1899 when the question of ovarian retention after hysterectomy first received serious consideration a voluminous literature has accumulated embodying the results of numerous clinical investigations of this problem. Mandl and Buerger's exhaustive monograph contains an excellent review of the earlier contributions while helpful later bibli-

ographies will be found appended to the more recent articles of Schickele, Walthard, Vineberg, Graves and Culbertson. In reviewing this literature one experiences disappointment over the conflicting opinions met with regarding a number of the points which must be determined from clinical data. I will summarize the results of a few of the most important statistical studies that have been made.

Mandl and Buerger in 309 cases of total ablation observed menopause symptoms in 80 per cent. Of these 49 per cent developed symptoms very promptly after operation. Of 96 cases with retention of one or both ovaries 68 per cent subsequently developed what the authors style as symptoms of a general nature. In 3 per cent of these the symptoms were only periodic which they interpret as an indication of functioning ovaries. The sexual function was impaired in 42 per cent of the total ablation cases and in only 18 per cent of the retention cases. The incidence of postoperative obesity, trophic and psychic disturbance were not strikingly different in the two groups but the variations observed were uniformly in favor of the retention cases.

Mainzer concluded from his studies that the removal of normal or lightly diseased ovaries causes especially stormy ablation symptoms and that while retention may not always prevent the later development of symptoms these are mild and of the menstrual type. He saw no case with retention exhibit the severe syndrome following total ablation.

Burckhardt noted the appearance of menstrual menses in 100 per cent of his retention cases. Ablation symptoms developed in about one half of the cases both with retention and total ablation. The sexual function was favorably influenced by retention. He saw no injury to the health of patients from retention and advocated it in order to ameliorate the later menopause syndrome.

Werth from his exhaustive study of 118 cases of which 35 were instances of ovarian retention advocated retention not only before but after the menopause age. He vigorously attacks the idea of frequent oc-

currence of ovarian tumors from retained ovaries and concludes that the ovary has an important function in the body economy which warrants its retention in spite of certain clinical objections.

Claevecke attributes the disturbances observed in retention cases to operative injury of the ovary or to coexisting disease. He considers it established that ovulation continues to the normal menopause in retention cases.

Leopold and Ehrenfreund studied 151 cases of hysterectomy on account of myomata, 43 of which were examples of ovarian retention. Of these 50 per cent had disturbances in one half of which the symptoms appeared before the climacteric age. They observed no alteration of the sexual function and no trophic disturbances.

Dickinson from a careful study of 131 cases of ovarian retention after an interval of six months and over subsequent to hysterectomy concluded that 80 per cent were free from menopause symptoms, that the results were better in cases with retention of both ovaries than with only one or than after resections that the disturbances met with were more gradual and less severe than after total ablation and that retention in operations for pelvic infections is relatively less satisfactory. He condemns the removal of healthy ovaries at or near the time of the menopause since the exact period of ovarian activity is unknown. He has not had to reopen an abdomen when a conservative operation was done.

Graves last year reported his findings in a postoperative statistical study of 33 cases of total ablation and 26 cases of ovarian retention after hysterectomy. His clinical data appear to have been obtained through letters of inquiry sent to patients with reference particularly to one symptom—namely, hot flushes. This symptom he chose as a standard and found it in 80 per cent of the total ablation cases and 81 per cent of the retention cases. He states that it was reported by many patients who had passed the natural menopause at the time of the operation and he considers this fact evidence that the ovary retains its influence as a secretory

organ long after ovulation ceases. But in spite of this admission of continuation of ovarian function long after cessation of uterine function he contends that normal ovarian function is dependent upon a vital physiological connection between the ovary and the uterus. Hot flushes he seems to regard as tantamount to cessation of all ovarian function and employing this arbitrary standard throughout his study he reaches the remarkable conclusion that retention of ovarian tissue after hysterectomy is of little or no physiological value.

Such radical teaching should not be permitted to stand unchallenged, especially when it rests upon so insecure a foundation as clinical data compiled from letters of inquiry and classified according to the incidence of hot flushes upon the unique assumption that this symptom alone may be safely accepted as a reliable and scientific indication of the varied and complex activity of the ovary.

Graves supports his advocacy of total ablation by citations respectively from Walthard and his associates from Schickele and from Konstantinidis to the effect that menopause symptoms occur with equal frequency in cases of retention and of ablation. But a careful examination of these several reports shows that in them it was not the purpose of any of these authors to advocate total ablation. Thus Schickele says a vasomotor symptom complex occurs in retention cases as often as in ablation ones. He insists however that these phenomena shall be designated as retention symptoms in the cases with retained ovaries in contradistinction to the ablation symptoms of cases with complete removal of ovarian tissue. He states further that the retention symptoms need to be further studied. The inference of course is that he recognizes differences between the two clinical syndromes an observation which certainly does not support the theory of total ablation.

Walthard while at Bern, Switzerland through the influence of Professor Paul Dubois became enthusiastically interested in the psychoneurotic side of gynecological patients. His report includes three extremely interesting tables. The first one shows that

of 64 cases studied prior to removal of their pelvic organs even commonly recognized ablation symptoms were found in percent ages varying from 14 to 46. The second table shows that after a period of at least one year subsequent to total ablation of the pelvic organs in 51 of these same cases examined the even ablation symptoms were found to have completely disappeared in from 7 to 3 instances. The third table shows that of 65 cases with normal genital organs and free from any other organic disease nine of the common ablation symptoms were demonstrable in percentages varying from 44 to 64. The age of the patient was found not to be a factor in any of the groups studied. Walther concludes from this investigation that the so called ablation symptoms are neither the direct necessary result of any genital disease nor of the loss of internal secretion of the ovary nor of the loss of the genital function. He considers them due to a hypersensitive nervous system and psychoneurotic in origin. Whether we agree with him or not his report certainly cannot be considered as supporting total ablation. It does however strikingly emphasize the caution which must be observed in the present state of our knowledge in drawing conclusions regarding ovarian function from the incidence of one or more so called ablation symptoms.

Finally Konstantinidis reported a post operative study of 100 cases of hysterectomy with retention of both ovaries and 34 cases with retention of one ovary. One sentence from his summary states that of these 134 cases one half showed more or less vasomotor nearly one third trophic and about one seventh psychic disturbances. This sentence has been used by the advocates of total ablation to support their contention. But a careful reading of the full report shows that it cannot be justly so construed.

Of the one half with vasomotor disturbances in only 37 per cent of them were these symptoms severe and nearly one half of these were furnished by the group from whom one ovary had been removed. Of the one third exhibiting trophic disturbances by which the author means a slight tendency

to adiposity only 3 per cent were found in the group in whom both ovaries had been retained. Furthermore a majority of all the patients showing this tendency to adiposity were at the normal menopause age. This study therefore argues eloquently for ovarian retention.

These citations represent fairly the available clinical data and suffice to illustrate the conflict of opinion and confusion which such studies have brought about. The truth of the matter is that no clinical investigations have been made with proper regard for all of the various factors which in reality determine the fate of retained ovaries and without knowledge of which one cannot possibly estimate with any degree of accuracy to what extent hysterectomy has disturbed their function. These factors are (1) a knowledge of the individual patient's condition prior to hysterectomy both in the psychic domain and in that of the autonomic nervous system as already outlined (2) the cases must be grouped according to age both at the time of operation and at the time of subsequent observation (3) they must be grouped according to the pathology for which the operation was performed and (4) with reference to the operative technique whether or not proper measures were used to safeguard subsequent ovarian circulation.

#### CONCLUSIONS

1 The ovary is a glandular organ of complex function our knowledge of which is at present far from complete.

The uterus is not essential to a continuation of ovarian function except as regards menstruation and reproduction.

3 The advocates of total ablation have not furnished convincing evidence of the correctness of their contention.

4 The disturbances of ovarian function attributed to hysterectomy are partly those associated with normal menstruation and partly those arising from damage to the ovary through operative trauma or disease.

5 The weight of evidence furnished by anatomical experimental and clinical investigations is overwhelmingly in favor of retention of sound ovaries both before and after the menopause age.

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## PATHOLOGY OF GOITER

BASED UPON SPECIMENS RECEIVED AT THE STATE INSTITUTE FOR THE STUDY OF MALIGNANT  
DISEASE BUFFALO NEW YORK

By BUPTON T SIMPSON BUFFALO NEW YORK

Plth 1 g t

IN writing upon the pathology of goiter it seemed to me to be a good plan to classify all the thyroid specimens which came into the laboratory for diagnosis. This ought to give a fair pathological classification especially for the immediate region of Buffalo from which we naturally receive the majority of our specimens. As is well known the term goiter is a purely clinical one and is usually given to any permanent enlargement of the thyroid gland.

The classification which I have indicated below seems to embody all the pathological conditions in which we find enlargement of the gland.

## CLASSIFICATION

Simple goiter

A Physiological

B Toxic

Multiple adenomata

A Cystic

B Solid

Colloid goiter

Exophthalmic goiter

Neoplasms

Acute or chronic inflammations are not included in this classification. The specimens received at the laboratory may be almost entirely put into the last four divisions. Simple goiter usually does not come to operation especially in the early stages and moreover many of these cases either recover spontaneously or are amenable to medical treatment.

There are especially in Europe in the mountainous regions areas or districts which are known as goitrous districts in which the so called endemic goiter is very common.



In these places a large proportion of the population are affected by markedly enlarged thyroids. Buffalo in common with other cities on the southern borders of the Great Lakes is considered a goitrous region although we have only the incipient endemic goiter and rarely is marked as that common in the European goitrous regions.

Under the clinical term goiter we have grouped five distinct and separate diseases. The only thing which they really have in common is the enlargement of the thyroid gland, this being the usual sign for which the medical man is consulted.

I wish to take up each group speaking briefly concerning the etiology gross and microscopic pathology. It might be well to review briefly the histology of the thyroid gland. The thyroid gland takes its origin from the upper anterior portion of the gut tract being therefore derived from the endoderm. The gland consists of two lateral lobes connected by an isthmus. It has a thick connective tissue capsule which ends down trabeculae which divide the gland into lobes and lobules. The unit of the thyroid gland is the follicle a little sac which is lined with a single layer of low columnar epithelium the basal ends of which come into intimate contact with capillary blood vessels the lumen of these little sacs or vesicles being usually filled with colloid material the active secretion of the thyroid cells. The follicles are surrounded by a rich network of lymphatics into which many authorities believe the secretion may be thrown although by others it is believed the secretion is absorbed directly into the blood stream. These follicles do not communicate with each other but are grouped into lobules by connective tissue and surrounded by trabeculae sent in from the capsule.

#### SIMPLE GOITER

The first group simple goiter may be divided into a physiological simple goiter and toxic simple goiter using the word toxic in an etiological sense.

*Physiological simple goiter* is the term applied to the temporary enlargement of this gland which occurs at puberty during menstrual periods and especially in pregnancy.

The exact cause of this enlargement is not known but the mechanism of the enlargement is usually due to vascular dilatation. It probably has some relation to the sympathetic system. The gland is slightly enlarged smooth and usually symmetrical. This enlargement is generally only temporary but repeated physiological enlargement may lead to simple goiter which is accompanied by true hyperplasia probably due to repeated irritation and increased blood supply.

*Toxic simple goiter* is that variety of true goiter which occurs with such frequency in certain mountainous regions and is usually designated as endemic goiter. It is also the type which we see in younger people along the cities of the Great Lakes. Manne has made a study of the girl of the schools of Akron Ohio examining the thyroids of 3,872 from the fifth to the twelfth grades ages averaging from twelve to seventeen and found that 56 per cent showed enlargement of the thyroid gland. This is the type of simple goiter which occurs in Buffalo and its environments. Among the chief theories for its causation may be mentioned especially those of Bircher and of McCarron each of which we will briefly allude to. There are two factors in the etiology of goiter that nearly all authorities are agreed upon that is first the relation of drinking water to goiter and second in especial susceptibility of some thyroids to certain influences. One of the older theories and one that was accepted for some time was that of Bircher who believed that the changes in the thyroid gland were due to toxic material which he took to be a chemical of a colloid nature and was associated with water of the so called goitrous wells or streams which nearly always sprang from certain of the older geological strata. This water originated or passed through certain organic ediments deposited in these layers. H. Bircher when examining recruits in military service noted that certain groups of individuals from certain districts showed enlargement of the thyroid gland. After the war he investigated these districts and noted the relation to the drinking water. He also observed in a neighboring town the great difference in the prevalence of goiter on either

side of the stream which ran through this town people on the right bank having 80 per cent of goiter while on the left bank only about 10 per cent. The water supply was obtained from different sources. By changing the supply of the high goitrous district and obtaining water from the other side of the stream the goiter incidence was reduced to 2 or 3 per cent. He found that these so called goiter wells or streams had their origin in certain geological strata as mentioned above. His son Eugene Bircher carried on animal experiments especially with rats and found that by feeding these rats upon drinking water from the so called goitrous wells he was able to produce enlargement of the thyroid gland in these animals.

The second theory is that of McCarrison who worked in the region of the Himalaya Mountains in India. McCarrison made extensive investigations in a goitrous district and came to the conclusion that the thyroid changes were due to toxic substances of infectious origin and that the chief seat of the infection was to be found in the intestinal tract. His experiments are very convincing. He was able to produce enlargement of the thyroid gland by feeding faecal matter from goitrous people to animals. He also fed the precipitate on Berkefeld filters which was obtained by filtering water from goitrous wells to humans producing thyroid enlargement and was successful also in curing certain cases by the use of intestinal antiseptics as thymol salol etc. McCarrison speaks of several cases of enlarged thyroid which were caused to disappear by operative procedure on intestinal conditions especially in Lane's kinks etc. One remarkable case which he reports cured by this means was in a girl with a severe case of exophthalmic goiter. While McCarrison isolated anaerobic organisms from the intestinal canal in goitrous patients and had some success using this organism as a vaccine he does not claim to have found a specific organism but thinks that organisms of the colon group may be largely responsible.

Marine who has done extensive work on the thyroid gland especially on the lower animals believes that the enlargement of

this organ in simple goiter is often associated with the lack of ability of the body to get iodine or to assimilate the same and that therefore the thyroid gland hypertrophies to compensate for this condition.

Simple goiter occurs at any age but is more frequent between the ages of twelve and twenty and while this condition occurs in males it is much more frequent in females. The gland is usually small symmetrical and smooth although either lobe may be enlarged over the other or the enlargement may be located in the isthmus. Microscopic examination shows a hyperplasia that is an increase in all the constituents and also a new formation of vesicles. This increase is symmetrical. While the epithelium becomes high cuboidal or columnar still there is no tendency to papillar formation or an increase in the layers lining the alveoli. The colloid material is usually increased and stains more deeply than in the normal thyroid gland. It is to this type of thyroid enlargement that the name of goiter properly belongs.

#### MULTIPLE ADENOMATA

By far the greatest number of the enlarged thyroids received at the laboratory with the diagnosis of goiter is really true tumor formation. Whether or not true statistics of all cases of enlargement of this organ would show that the majority comprises the group of multiple adenomata or if this form is the most frequently operated upon nevertheless the fact remains that 65 per cent of all enlarged glands received at the laboratory are of this type. It is a true tumor formation and is usually multiple. The accepted etiological factor is that these tumors spring from remnants of ducts which it is supposed were to be found in the organ when in former times it was a duct gland. It is easy to find these remnants of ducts with their high columnar epithelium in thyroids of the newborn. While these nodules or adenomata may appear at any time after birth they usually are to be found at puberty and make their appearance at this time and gradually enlarge until at the age of thirty or thirty five years they become marked goiters.

It is interesting with the knowledge which

we have of the frequency of this type of enlargement to read in various treatises on the thyroid how the author dismisses this type of pathological condition apparently with a wave of the hand with the remark that sometimes Wollfer's foetal adenomata are to be found in the thyroid gland and this is especially striking when as a matter of fact A choff in his lectures claims that he can find these adenomata in the thyroid gland of every individual who comes to autopsy from the region of Freiburg in Breisgau. The writer found them in 80 per cent of two hundred consecutive autopsies in this region.

This type may be divided into two histological classes—the cystic and the solid.

It is to this variety of enlargement of the thyroid gland that we have the many different names: a cystic goiter, fibrous goiter, hemorrhagic goiter, etc., and only in this variety that the condition exists which give rise to these various names. The tumor may be usually irregular and nodular and for this reason has been given the name of *struma nodosa*. Early this form may be confused with simple goiter and later the cystic variety may be confused with colloid goiter. Section of these enlarged thyroids show all the so-called degenerative change and various color which are due to hemorrhagic change and calcareous infiltration. One can follow the growth of these tumors from the small nodules to the large diffuse adenomata or cystic areas. They are differentiated from all other forms of enlargement of the thyroid gland by the distinct nodular tumor mass, even though they be cystic and colloid. All other forms of goiter still retain the characteristic lobular form of the gland, the pathological areas being separated by trabeculae while the true tumor formation shows no trabeculae dividing them into lobules. In some cases the surrounding thyroid tissue becomes compressed forming capsules to these nodules.

The cystic variety is composed of large vesicles filled with colloid material, the secretion of the tumor cells, and as lymph vessels are not contained in these tumors there is no absorption of this colloid secretion which thereby accumulates and forms cystic structures and in this way may resemble the col-

loid goiter. Also in this variety probably due to the effect of secretory materials on the muller vessel walls there is great tendency to hemorrhage.

The solid variety is very cellular with high columnar epithelium containing very little colloid material. As these adenomata increase in size they always show degenerative changes at the center, the tumor cells undergo necrosis and their places are taken by new formed connective tissue which soon undergoes especially hyaline degeneration. In some cases the epithelium proliferates irregularly and no doubt these cells secrete material which give toxic symptoms for our statistics show that 3 per cent of the enlarged thyroids diagnosed as exophthalmic goiter showed upon microscopic examination to be very cellular adenomata.

#### COLLOID GOITER

Nineteen per cent of the specimens received were colloid goiter. Colloid goiter might be designated as a passive enlargement of the thyroid gland, it being simply a collection of colloid material filling the alveoli until their walls become very thin and sometimes rupture into each other. It is considered that colloid goiter is really a healed goiter, that at one time the thyroid gland was the seat of either thyroiditis, simple goiter, exophthalmic goiter or some other pathological condition and the cause of the disease being eliminated the active process ceased and the cells continued to secrete colloid material but the absorption of this apparently is interfered with and it accumulates in the alveoli.

These goiters are large and symmetrical with a smooth surface. Cut surface shows large alveoli filled with colloid material. Microscopically the alveoli are large filled with thick colloid material. The epithelium is compressed and flattened. In this type of enlarged thyroid we do not find the so-called degeneration or evidence of hemorrhage and the lobular arrangement while greatly enlarged is still preserved by the trabeculae.

#### EXOPHTHALMIC GOITER

Light per cent of the specimens were exophthalmic goiter. There is considerable controversy concerning the etiology of this

disease the main question being whether the disease is primary in the thyroid gland or primary in the nervous system especially the sympathetic. Crotti after a careful and elaborate discussion of the observations and experiments in this disease concludes that the disease is primary in the thyroid gland being a toxic irritation from infectious toxins from various sources as the intestinal tract pyorrhea tonsillitis or other chronic infections. He does not however hold that there is a specific organism. He speaks especially of a vicious circle that is the infectious toxin stimulates the thyroid to throw out its secretion which stimulates the sympathetic nervous system which in turn stimulates the thyroid again in this way forming the so called vicious circle. An interesting observation is that exophthalmic goiter is uncommon in regions where simple goiter is endemic.

The thyroid gland is not greatly increased in this disease. It is usually symmetrical but may be more marked in one lobe. In some cases the gland may not be clinically enlarged but in every case there is a specific pathological picture of hyperplasia of the gland. Cut surface reveals compact areas grayish in color and shows no exudate. Histologically the alveoli are increased in size and number and become very irregular in shape. The epithelium is high columnar and may be several layers thick and with marked tendency to papillary formation which is almost pathognomonic for this disease. Colloid material is decreased and may be entirely absent from the follicles but when present stains rather faintly.

#### NEOPLASMS

I have added the neoplasms because 4 per cent of all the thyroids received show malignant disease. While the thyroid may be the seat of benign tumors as fibromata chondromata etc. these tumors are the same as occur in other parts of the body springing from the mesoblastic tissue. Sarcoma is not rare and is usually of the spindle cell variety and springs from the connective tissue element. It is no more specific for the thyroid than for other tissues of the body and usually originates in a normal gland in younger persons.

Ninety per cent of the carcinomata spring from pre existing goiter and occur in individuals past forty. One should be suspicious of malignant change when a goiter in a person past forty suddenly begins to enlarge in size. Malignant epithelial tumors of the thyroid gland have a great tendency to metastasize in bone. It is also possible to have metastatic thyroid tumors from enlarged thyroids which do not give a histological picture of malignancy.

#### DISCUSSION

In reading various articles upon goiter one is struck by the apparent lack of uniformity in the classification of these conditions. As I have said goiter is a clinical term and is sometimes employed indiscriminately to any enlargement of this organ. It is the opinion of the writer that much confusion exists by the classification of various distinct processes under one head especially in goitrous regions and by statistics upon the collection of these various conditions. It is well to keep in mind that simple goiter is probably a toxic hyperplasia of the thyroid gland in younger people especially females and occurs between the ages of twelve and twenty. This process in the majority of cases spontaneously recovers but may continue and may reach the colloid healed state. At about the age of twenty the adenomata proliferate in the thyroid gland and begin to evidence themselves by the appearance of marked enlargement of the gland and from twenty to forty we have the adenomatous type of enlargement. This may occur in glands which have been the seat of simple goiter or may occur in glands which have been apparently normal. So we may therefore have before twenty the simple goiter and after twenty colloid goiter or adenomatous goiter. Exophthalmic change may occur in the normal gland in the gland the seat of simple goiter in colloid goiter or in adenomatous goiter.

#### RECAPITULATION

To recapitulate briefly the specimens of enlarged thyroids which come to the laboratory for diagnosis can be classified into five groups namely simple goiter multiple

adenomata colloid goiter exophthalmic goiter malignant neoplasms

These are all characterized by the common factor of enlargement of the thyroid but otherwise differ markedly from one another. They may be differentiated clinically in nearly all cases by careful examination which seems to be desirable for the selection of proper treatment. The physiological simple goiter is simply a vascular dilatation and is goiter only in the sense of the enlarged gland which however is often only of temporary duration.

Simple toxic goiter is an enlargement of the thyroid gland due to a symmetrical hyperplasia of all the structure of the thyroid and without the clinical evidence of toxic symptoms most probably caused by toxic factor. This form which is usually called endemic goiter is almost always associated with drinking water which probably has to do with carrying the infection or toxin.

Multiple adenomata is the most common cause of thyroid enlargement in our vicinity at least so far as our statistics show which are of course based upon operative material sent in to the laboratory. It is a true tumor formation beginning probably in remnants of embryonic ducts occurring about the age of puberty. These tumors start as minute adenomata in different parts of the gland and gradually increase in size causing the nodular form even in later life and having a great tendency to the so called degenerative change which give this form of enlargement its numerous names. It is well to remember that these adenomata when very cellular may give toxic symptoms and thereby become confused clinically with exophthalmic goiter.

Colloid goiter is simply a passive accumulation of colloid material in the dilated alveoli and it is usually considered as a healed state of some previous pathological condition of the thyroid gland.

Exophthalmic goiter even if it be not of primary thyroid origin has its specific patho-

gnomonic histological picture and there can be no doubt of the toxic effect of the excessive secretion of this gland.

The neoplasms really ought not to be included in a goiter problem and are only included here because they make up a part of the enlarged thyroid received at the laboratory.

In closing I would draw your attention to the fact that 5 per cent of the thyroid specimens received at the laboratory showed a combination of some of these lesions that is colloid goiter may show adenomata and a large adenomatous goiter may show areas of true Graves disease. Consider this fact it may explain that certain unfavorable results in operative procedure may be due to leaving part of an area of exophthalmic goiter in the removal of an adenoma or of a colloid lobe.

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## HYPERTROPHIC STENOSIS OF THE PYLORUS IN INFANTS

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Att d S g t th J m W lk M m l Hosp t W lm t

AND

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Mt d g P d t t tl M Spru t M m l Hosp l

THIS condition was first described by Hirschsprung (1) in 1888 but not until 1897 has much appeared in the literature. Since then however the condition has attracted more and more attention until within the last decade much has been written upon this subject.

We regard this condition as a distinct pathological entity and we feel that it should not be confused with those gastric disturbances which sometimes present some of its symptomatology. One can not help but realize that many children have heretofore been sacrificed because this condition was not recognized. This is unquestionably due to the fact that many authorities believed the condition to be due to a pyloric spasm. Every one seems to be agreed that pylorospasm does occur in neurotic infants and produces vomiting but there are few clinicians now who do not recognize the difference between this condition and hypertrophic pyloric stenosis.

## PATHOLOGY

We regard this condition as a congenital hypertrophy of the pylorus muscle which is seldom sufficient to produce obstruction but when obstruction does occur it is due to a spasm of the hypertrophic pyloric muscle. These cases which appear to be cured by medical treatment are not cured of the hypertrophy but are relieved of the spasm. Indeed Holt (2) cites instances in which he could still palpate the tumor in medically cured cases where no surgery was done. On the other hand Lewis and Grulke (3) have shown that the hypertrophic muscle remains for years after a posterior gastroenterostomy. So also has Scudder (4) shown this. Rosenheim (5) had a case of a boy  $6\frac{1}{2}$  years old in whom the symptoms had existed off and on since infancy. Other reasons for considering it a congenital condition are that it is often found

with other anomalies such as club foot, hair lip, etc. Hill (6) cites two cases occurring in one family with a history of its occurring before. There is sufficient time for the hypertrophy to take place before birth since we know that the pyloric muscle begins to appear at the end of the third month of foetal life. Cautley (7) cites a case of Dent's in which he found it in a seven months foetus. In one of our cases it was demonstrated on the third day of life the child apparently having been born at term. There are a few who hold the belief that constant spasm produces an overdevelopment of the pyloric muscle. However the evidence of the congenital origin of the hypertrophy seems to be in preponderance to us. Holt (8) says that spasm has never been known to produce hypertrophy.

## SYMPTOMS

This condition is attended by a very definite symptomatology which in itself should serve to make a diagnosis. If every infant be carefully observed the diagnosis between it and other gastric conditions associated with nausea and vomiting should be made.

According to Hill (6) it occurs in one in every 100 babies. The onset is always abrupt. It is seen most often in breast fed male infants. Holt (8) found 52 out of 56 cases were in breast fed children.

**Vomiting.** It usually begins at the end of the third week but may occur earlier or later. The vomiting is projectile in character. It does not often attract the attention of the mother at first but is so characteristic later that a diagnosis can almost be made by it alone.

The material vomited depends not upon the quality of the food taken but upon the quantity. It occurs during or at the end of the feeding, sometimes ejected several feet



hours and a large given four times a day. One week later the mother returned to the office and reported that the baby had been spitting up much less in quantity only about one tablespoonful after nursing and not after each nursing but three or four times a day for the past three days one to three tablespoonfuls three times a day not projectile. The child weighed 6 pound 1 ounce. The child was still hungry and still constipated. There was no gastric wave and no tumor felt at this visit. Four days later the mother returned with a very different story. The baby looked much worse and the mother said that the baby had vomited everything taken for the past 48 hours and stated that it spurted from the baby's mouth. At this examination the baby showed typical gastric peristalsis crossing the median line and a large easily felt tumor. At this time we wondered how we could have missed feeling it at the previous examinations. Weight at this time was 6 pounds 4 ounces 10 of a whole pound in two weeks. Six hours later he was operated upon by Dr. Green and a very hard cartilaginous like tumor of the pylorus was demonstrated. The Rammstedt operation was done requiring twenty minutes. The patient made an uneventful recovery and was discharged from the hospital in ten days having gained 5 ounce. His retention taken one time only three hours after feeding was 60 cubic centimeters.

**CASE N D** Age 21 days one of twin boy weight 1 pound 6 ounces breast fed. The child had been vomiting for two weeks and had marked constipation for ten days. The vomiting was not marked for the first week only about three times a day and about three tablespoonful at a time but always came immediately after nursing. For the past week the vomiting had been projectile and after taking anything by mouth even water. He had lost much in weight. He was very much smaller than his twin brother who was smaller than he at birth. The family history was negative. Examination showed a poorly nourished baby with eye sunken and skin wrinkled and non-elastic. Projectile vomiting was very marked there was typical gastric peristalsis and a hard easily felt tumor. Stool were absent. Gastric retention 30 cubic centimeter three hours after nursing. The child was seen at night in consultation in an immediate operation was advised but it was the following day before consent to operation is given and at operation a very typical cartilaginous like tumor was found. The Rammstedt operation done in 15 minutes. The recovery uneventful and the patient was discharged on the seventh day having gained 4 ounce. At 1 month of age he weighed 4 pound which is three pound more than his twin brother.

**CASE M W** Age 3 months 1 week girl weight 5 1/2 and 10 ounce breast and bottle fed. Vomiting occurred after each nursing for nine weeks. Constipation had been present for six weeks. She was born at the mother's first pregnancy which terminated in normal labor at term. The child had



FIG. 1. Case 1 at 12 months. Weight 4 pound. Operated on at 6 weeks.

been breast fed exclusively for four weeks at which time the baby began to vomit and a bottle was advised. For the past two months she had had a number of different formulas all of which proved unsuccessful. The baby seemed very hungry but would vomit about an ounce just after or a few minutes after finishing the bottle and would repeat this once or twice before the next feeding. Examination showed a poorly nourished pale child with gastric peristaltic waves but no tumor could be felt. The patient was given medical treatment for three weeks and a modified formula and breast milk varying strength during this time but there was no definite improvement. A gastric lavage was given four times a day for ten days and then four times a day with no definite improvement but rather to the contrary the child was losing ground steadily but not so rapidly as the mother said it had the month previous. Gastric retention three hours after feeding repeatedly showed 60 to 80 cubic centimeter on two different occasions 4 hours after a feeding 30 to 40 cubic centimeter. During medical treatment for three weeks there was a loss of 10 ounces and he was not improving as we felt she should. At no time was a tumor felt by either of us or by two other colleagues. In the face of the loss of weight the typical gastric peristaltic waves and the failure to respond to medical treatment we advised operation as we feared to wait too long. A Rammstedt operation was done and a medium sized soft pyloric tumor was found. During the





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child was breast fed and nursed whenever he cried and that was nearly all the time. The child was born of the mother's first pregnancy which terminated in normal labor at term. Birth weight 6 pounds 9 ounces. The child was seen only once at the clinic and on examination very typical gastric peristaltic waves were seen and after feeding or during the feeding he ejected at least two ounces of sour curdled milk to a distance of one foot. No tumor could be felt at this examination. The mother was strongly advised to let the child stay in the hospital for observation but she refused and also refused to let either a doctor or a nurse see the child afterwards for fear that they would operate on the baby. Indirectly through other patients in the same neighborhood I kept some track of the baby. The baby continued to vomit to what extent I could not say but it did continue to a greater or less extent for six weeks after I saw the baby and then the vomiting became less. Now the baby is gaining in weight and vomits very little according to the report. If this was a case of pyloric obstruction which of course we can not say definitely it was a spontaneous improvement.

#### TREATMENT

When this condition was first described it was assigned to the surgeon for treatment. His results however were so discouraging that other methods were attempted in some instances with flattering results notably a series of cases treated by Hutchinson with 20 per cent mortality. We are inclined to think that many of these so called medical cures were after all cases of pyloric spasm and not hypertrophy. Granting that they were hypertrophic they were relieved of the spasm which had supervened on the hypertrophy and produced obstruction and allowed to go on with the hypertrophy which is always prone to relapse. Since 1905 however with the perfection of the technique of gastro enterostomy the surgical treatment of this condition has once again occupied the foreground. Scudder (10) reports a series of 36 gastro enterostomies covering his cases. Richters and Stillmans with a mortality 13.8 per cent while others show an improvement in their mortality percentages as time goes on. In 1915 Rammstedt (11) describes his operation of dividing the pyloric muscle fibers down to the mucous membrane and partially separating the muscle ring from the mucous membrane allowing the mucosa to bulge up into this wound. This we believe

is going to be a distinct advantage in the treatment of this condition and will serve materially to lower still further the mortality rate. While we cannot but admire the record that Scudder (10) and Richter (9) made with gastro enterostomy we are of the opinion that gastro enterostomy is a far more serious operation than the Rammstedt procedure and will sooner or later give way to the much simpler operation which accomplishes the same result with less danger to the patient and which permits of the giving of food and fluids so much sooner establishing a more speedy convalescence. The Rammstedt operation is accomplished in from 15 to 30 minutes from the beginning of the administration of the anesthetic until the child is taken from the table. In one of our cases this was accomplished in 10 minutes.

One must of course use care to avoid tearing through the mucous membrane. This can readily be done if the separation of the pyloric muscle after its division is begun at the stomach side and we proceed gradually toward the duodenum. If however a small tear is made it can readily be taken care of by clamping and ligating at this point with a fine silk thread as one would ligate a vessel. A stomach tube should always be passed after the abdomen is opened to allow the air which the child has swallowed while taking the anesthetic to escape from the stomach. As a matter of course we also precede each operation with a gastric lavage. After the operation on the pyloric muscle is completed the stomach tube is inserted the stomach inflated with air to determine whether or not any perforation of the mucous membrane has occurred. In this way perforation can be demonstrated and taken care of when it might otherwise be overlooked. Feedings are started as soon as the child awakens from the anesthetic which is usually about two hours.

To Downes (1) must be given the credit of demonstrating the efficiency of the Rammstedt operation. His results are most striking but we also realize that the medical care of these cases after operation is just as important as a successful operation. Often bad judgment in feeding or in changing a

## AUTHOR'S CASES

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feeding may cause a fatality where the operation has been thoroughly successful.

The cases must have *breast milk* and they must have it in small quantities at the beginning and it must be increased slowly. In our case we have followed the method adopted at the Babies' Hospital, New York. We start the feeding two hours after the anæsthetic or when the baby is well awake from the anæsthetic with 4 cubic centimeter of breast milk and 4 cubic centimeter of barley water every three hours increasing 4 cubic centimeters of breast milk every other feeding until we get the breast milk up to thirty cubic centimeter and then we give thirty cubic centimeter of breast milk every three hours during the day and every four hours at night. The baby is not allowed to nurse the mother for from 5 to 7 days after operation and then the baby is weighed before and after nursing to determine the amount he gets. Castor oil is given 4 hours after operation. Practically every case that we have treated has received an antiseptic hypodermoclysis. Some few received hypodermoclysis after the operation. The

greatest care is taken not to chill the baby during operation and external heat is applied for a number of hours after operation. Should a diarrhoea follow the operation we would treat it the same as other diarrhoeas with protein milk or protein and breast milk. We must remember that these cases are feeding cases still and some of them may remain difficult feeding cases and when the surgeon has finished the operation the baby should be turned over to some one who has some skill in feeding infants. In these cases more than any other the co-operation of the surgeon and the pediatrician is required for success.

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## A THEORY ON THE ETIOLOGY OF THE TOXÆMIA OF PREGNANCY WITH OR WITHOUT CONVULSIONS

By JOHN E. TALBOT M.D. WORCESTER, MASSACHUSETTS

MUCH has been written in regard to different methods of treating the complex of symptoms known as the toxæmia of pregnancy with or without convulsions and many different theories as to the fundamental cause of this condition have been evolved. Many of the profession are still hard at work collecting further data in an endeavor to locate the fundamental cause. That this cause is not yet satisfactorily established seems generally understood.

Certain clinical facts have recently come to my notice which by their extraordinary nature seem to me to throw some light on this subject. The interpretation of clinical facts can never be a matter of absolute logic on account of the number of factors involved but the extraordinary nature of certain facts may give a reasonable ground for making a deduction the truth of which is increased by the extraordinary nature of the facts from which it is made.

The deduction which I have made is that the fundamental cause of toxæmia of pregnancy with or without convulsions is not in the products of conception.

The history of the following case plus subsequent observations in other cases seems to me to raise a strong probability that this statement is true.

Mr. M. was curetted in December 1915 for an incomplete miscarriage at 3 months. Following the operation she had some cardiac decompensation and a diagnosis of mitral stenosis was made.

In spite of caution to avoid pregnancy on August 1, 1916 she told me that she was two weeks overdue. Throughout the pregnant period which followed she was carefully watched and the blood pressure and urine were normal at all examinations. There were no symptoms of toxæmia. Her pulse became progressively more rapid so that by the middle of February she could not move about without dyspnea and palpitation.

In consultation it was decided to put her to bed and then deliver by cesarean section. Accordingly on March 14 a cesarean section was done.

For the next few days the patient did very well. Pulse 110 and no fever.

On the 18th she complained of headache which became so severe on the 19th that it resisted morphine. On the 21st the patient had 12 convulsions and died on the 22nd. Blood pressure was normal on entrance to the hospital. On the 19th it was found to be 180. The bowels had moved two or three times a day since the operation.

Here is a case of postpartum eclampsia with no symptoms of toxæmia appearing until 4 days after delivery and then reaching its climax 7 days after delivery.

A postpartum eclampsia or toxæmia such as the case cited implies that the supply of poisonous substance causing the disease increases even after delivery to a point which gives the manifestations of eclampsia and thereby implies that the source of such a poison must be still present in the body after delivery.

It seems absolutely illogical to say that such fulminating symptoms will rise to their height seven days after the cause has been removed.

That the pregnancy itself plays a part in the causation of those symptoms must also be true. We need no more proof of this than what may be called the therapeutic test that is by termination of the pregnancy we frequently bring about an almost immediate abatement of symptoms in a large majority of cases. Thus we have two apparently inconsistent facts the unquestionable evidence that the symptoms are dependent upon the existence of a pregnancy and the evidence that the products of conception are not the primary cause. In solving the problem of the fundamental cause these two facts must be made to agree.

In August 1916 another case of extraordinary character came under my care and as this case forms the starting point of my subsequent observations I will report it in full.

Mrs. I, age 33, born in Massachusetts, married 6 years, no children. The patient's father died of chronic nephritis. Uncle and aunt on father's side died of kidney trouble. Aunt on mother's side ill

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In general the severity of the symptoms of toxæmia may be said to be proportional to the amount of sepsis present.

One of my private cases is such a marked exception to this statement as to warrant reporting. The lack of any symptoms attributable to the teeth during the progress of the case made me believe that the unbroken chain of cases previously observed was to be broken by this case which I report in full.

*Mr. To come under my charge at the end of the second month of her second pregnancy.*

Pa's history was negative except for history of her first pregnancy at which time she became infected and was 7 weeks in bed with right femoral phlebitis.

Throughout her pregnancy she had a normal blood pressure and normal urine. She had occasional symptom of dizziness and almost fainting spells but without other signs. These were at first attributed to nervousness as she had been severely punished at the first delivery by a two hour attempt at forceps delivery *without* *her*.

About two weeks before delivery she began to develop signs of hydramnios which increased gradually. At no time during the pregnancy had the fetal heart been audible and motion though felt was very slight. With the development of hydramnios a bad prognosis as to the development of the child was made. The membranes ruptured about two weeks before her date with the escape of a tremendous quantity of liquor.

After the rupture the fetal heart was audible in the left lower quadrant 140. Vertex above the brim but no small parts could be made out.

On arrival at the hospital her blood pressure was 150. Delivery was normal in about 20 hours from time of rupture of membranes. The child was a typical case of chondrolytrophia fatalis and after 2 or 3 gasps died. The placenta showed an infarct about 4 to 6 centimeters in diameter. Bleeding was abnormally profuse. Two hours after delivery the blood pressure was 185 and remained up for 3 hours dropping to 130 the next morning. The patient slept well but complained of headache in the occipital region and dizzy feeling when awake.

The following night at 3 a.m. he had 3 convulsions coming on during her sleep. Blood pressure 150. At 5 a.m. and 11 30 a.m. the blood pressure was 130. At 12 4 p.m. the patient complained of being dizzy and had two more convulsions. The blood pressure rose to 170 at this time but was down to 130 within a half hour and there it remained for the next two weeks rising only once to 148.

Up to the end of the first two weeks there was not a sign of pus anywhere. Inpection of the teeth was negative except for one pivot tooth in front. There were absolutely no symptoms from the teeth.

On the fourteenth day the patient developed a temperature of 104, pulse 148 with pain and tenderness in right breast. The breasts had been bound up at the start and the milk had subsided. Two days later a breast abscess deep against the muscle was opened and about one ounce of pus evacuated.

As the nipples had not been used this abscess seemed to be of hamatogenous origin and this gave me hope. At the end of another two weeks the breast having nearly healed she developed pain in the left kidney region with rise of temperature to 102 and pulse 140. Examination of the urine showed pus cells sufficient to warrant the diagnosis of pyelitis. Under treatment with hexamethyleneamine this subsided in less than a week.

It is important to note that at the time of the breast abscess and at the time of the pyelitis there was a definite rise in blood pressure corresponding to temperature curve.

Believing that the breast abscess and pyelitis were evidence of a pus focus somewhere the teeth were X-rayed completely and two pockets of pus thereby located one in the pivot tooth and one farther back in the upper jaw.

This case is important as it points out that the absence of local symptoms cannot be depended on to rule out the presence of focal infection.

The fact that in many cases there is evidence of activity in these pus pockets just preceding or associated with the occurrence of symptoms of toxæmia and the fact that the severity of the symptoms is in general proportional to the amount of chronic sepsis present are evidences which tend to show that there is a relationship between the chronic sepsis and the incidence of the disease.

Can this relationship be explained? I not only believe that the relationship can be satisfactorily explained but also that the explanation throws light upon other than purely obstetrical problems.

Among the many striking facts associated with the development of a normal pregnancy is the marked stimulation of the metabolic processes of the maternal system as evidenced by the increase in appetite, the increase in weight and the remarkable sense of well-being. The patient passes through a period which is described by the common statement that "I never felt so well in my life."

That this increase in metabolism throws a definite strain on the woman's organism is a fact of which we have clinical proof.

For example interpose a pregnancy on a damaged heart and we see clearly that the increase in the function of the body in order to develop the pregnancy will overtax a heart which has hitherto been sufficient for the needs of the body that we often get definite breaks of compensation which cannot be attributed to any other cause than the physiological process going on. Thus we see that pregnancy itself is a perfectly physiological process can break down the reserve power of one organ to the point of decompensation. If this be true why cannot this same physiological process break down the organ whose reserve may have been weakened by some previous or concurrent process.

Which of all the organs of the body is most consistently linked with this disease known as toxemia of pregnancy. The kidney, the main organs of excretion of the waste product of nitrogen metabolism give us our most reliable sign of approaching trouble. Not only do the kidneys link themselves with the vital process of the disease by giving us warning of approaching danger but they are more strongly linked by the similarity of the symptom which flows from kidney inefficiency which we know as chronic nephritis and furthermore by the marked increase in the incidence of the disease when pregnancy is interposed upon an already existing chronic nephritis.

That the waste product of normal physiological metabolism are injurious to the organism if man is retained is a universally true. Anuria if continued long enough always results in death. Anuria must primarily cause an increase in the concentration in the blood of the waste product of physiological metabolism.

If they are injurious to the body cell in abnormal concentration can it be truly said that they are *not* injurious in normal concentration.

It is a fundamental characteristic of all things in this world to wear out. It is not too much to assume that such a process must be present in the human system. It is perfectly reasonable to believe that arteriosclerosis is in old age is merely the end result of a purely physiological process. The blood

vessels being constantly bathed in a fluid containing these harmful excretory products gradually respond to their injurious effects resulting in what we know as arteriosclerosis. There is plenty of clinical evidence that by regulating the diet and activities of a patient suffering from arterio sclerosis the life of that patient can be prolonged. One of the principal results from controlling these two factors diet and exercise is to bring about a reduction in the production of the waste products of the body which must in time make a reduction in the concentration of the products in the blood.

If such a low wearing process is tenable at all it must follow that there is a slow subminimal injury to the kidney epithelium itself.

Normal pregnancy itself without question increases the total of the metabolic products in the body and with this increase of metabolism comes an equal increase in the total quantity of excretory product to be eliminated by the kidney. This increase in quantity must increase the percentage of concentration of the excretory product in the blood and therefore put a greater strain on the kidneys even in their world of mutuality a part of the reserve power of the kidney.

The great concern of the kidney is an increase in its excretion must be with the percentage of concentration of the excretory products in the blood. The reserve power of the kidney must consist in its ability to continue to excrete the waste product even in abnormal concentration. It must be all true that it is from the blood which is in the cle of the strain that is the blood which is in contact with the renal epithelium through which the process is carried on.

We have therefore a situation during a level pregnancy in which the kidney excretory organs are all doing to excrete a gradually rising tide of metabolic waste product which the waste product are injurious to the system if retained. This situation demands that the excretory apparatus of the body should be in its highest state of efficiency.

How do the pregnant strain of chronic epithelium affect this situation. We know that person suffering from acute and frequent

ly show a concentrated urine which not infrequently contains albumin blood and casts. It is generally agreed that these findings are the result of an inflammatory reaction on the part of the kidneys resulting from the toxins of the acute infection which the kidney is called upon to excrete.

If the toxins of acute infection are an irritant and injury to the kidneys so the toxins of chronic sepsis which are drained into the blood must damage the excretory functions of the kidney.

It is probable that they are like the metallic poisons acting as a foreign substance to the physiological processes of the body and just as we find chronic nephritis developing from chronic metallic poisoning so we have here in the toxins from chronic infection a perfectly good cause for chronic nephritis.

The fact that chronic nephritis is so common an ailment of the human race proves that the cause must be equally common. The insidious manner in which it develops suggests an equally insidious source.

It is not the purpose of this paper to discuss the causes of chronic nephritis but in view of the observations which were necessarily made in working up this paper I am convinced that could we eliminate the chronic sepsis which occurs in connection with the teeth we could surely eliminate the most potent cause of chronic nephritis.

How do the principles above set forth affect the pregnant woman?

Pregnancy in itself must be a purely physiological process no part of which is antagonistic to the physiological processes of a normal woman. It is generally so accepted. In a normal woman nature has provided a kidney function which is sufficient to carry on that organism. The kidney reserve power in a normal individual is known to be largely in excess of the needs of that normal individual. It is sufficient in the majority of cases to take care of the extra work which is necessitated by the increase in metabolic products resulting from pregnancy which must be excreted.

When however we start with a woman who has an impaired kidney function as evidenced by chronic nephritis then we

begin to get an increase in the incidence of those symptoms which go to make up the entity known as toxæmia of pregnancy. We start with a kidney with reduced reserve power and this might explain the increased incidence of the trouble.

If chronic nephritis occurred as a background preceding or concurrent with each case of toxæmia of pregnancy or eclampsia it would be possible to say that the increase in normal metabolic waste products resulting from the pregnancy was sufficient to overcome the reserve power of the kidneys which reserve power had already been lowered by the chronic nephritis present. But such is not the case. Toxæmia of pregnancy and eclampsia occur in individuals who show no evidence of any previous kidney trouble. This fact tends to show that the kidney reaction is only secondary to the underlying cause.

The important facts to be noted are however that the cause of the trouble is not primarily in the kidney but that the lack of proper kidney function causes an increased incidence thereby showing the immediate relation between the excretory function of the kidney and the occurrence of the symptoms.

What other evidence have we that this matter of elimination is the crux of the situation? Surely the treatment which has given the best results is the so called eliminative treatment. Here again is the clinical recognition of the fact that there is a retention of something in the system which if it can be reduced in amount brings good results. It is most reasonable to assume therefore that this something which may be termed a poison is in the blood stream.

The reaction of the kidneys in this disease of toxæmia of pregnancy is similar to that which occurs when there is a poison or toxin in the blood. The very fact that it is the liver kidneys and placenta that are most damaged as shown by the pathological findings at autopsy is significant. These three organs may be classed together as the principal organs of the metabolism of the blood. It is also important to note that it is in these three organs that the blood stream is the most sluggish.



It is then fairly clear that we have to do with a poison in the blood stream which is in such concentration that it cause the symptoms which we know as toxæmia of pregnancy. If this concentration can be reduced by increasing the power of the body to eliminate we secure an abatement of symptoms.

The problem which presents itself is therefore what is the source of the poison and why is the poison not eliminated.

I have shown that the incidence of toxæmia of pregnancy in the series of cases observed was coincident with a focus of chronic infection. I have raised the point that the toxins of acute infection cause an inflammatory reaction in the kidneys with an inhibition of their excretory function. I advance the point that the toxins of chronic sepsis are an irritant and an injury to the kidneys and cause a reduction in the reserve power of those kidneys. We have therefore in these individuals who have a focus of chronic sepsis a reason why their elimination is not up to normal.

The immediate cause of the syndrome of symptoms known as toxæmia of pregnancy cannot be found in the toxins of chronic sepsis. It seems clear that this cause must have a closer relationship to the pregnant state.

I have tried to show that the case of Mrs. M. is strong evidence that the immediate cause cannot be found in the products of conception.

We know beyond doubt that the normal physiological excretory products of the system are injurious to that system if retained. We all know that there is no other condition in nature where there is such a large quantity of these normal excretory products to be excreted as during a developing pregnancy.

Is it therefore a reasonable hypothesis to say that the symptoms of toxæmia of pregnancy with or without convulsions are caused by the retention of the normal physiological waste products of the developing pregnancy this retention being due to the damaged functional power of the kidneys which damage has been brought about by the toxins of chronic sepsis in the blood? There is clinical evidence that this hypothesis is true.

It is a most striking coincidence that the

symptoms resulting from chronic nephritis are so similar to those which occur in toxæmia of pregnancy and eclampsia that it can be safely said that there are no symptoms of chronic nephritis which do not occur in toxæmia of pregnancy and eclampsia. This great similarity of symptoms in it self implies a common cause.

If we assume that the symptoms of chronic nephritis are due to the retention of normal physiological waste products that it is these products which stimulate the rise in blood pressure that they stimulate the symptoms of headache blurred vision oedema vomiting and lastly convulsions and that this retention is due to a lack of eliminative functional power on the part of the kidneys is not the likeness of the two diseases made clear?

In the case of a chronic nephritic the excretory function of the kidneys is inhibited in the same way as in the case of an eclamptic. The demand made upon the kidney function in the former is however very different from that in the latter. The quantity of excretory products which the kidneys are called upon to excrete in normal life during the development of a chronic nephritis is more or less constant and the reserve power of the kidney does not break down under this constant until the damage has lowered the reserve power to a point where the kidneys can not carry off the normal amount of waste products necessary to maintain life.

The demand made upon the kidney function during a developing pregnancy is not a constant but a gradually increasing strain upon that function. It is therefore an acute process as compared to the development of a chronic nephritis.

The end results so far as symptoms are concerned resemble each other just as we should expect and it is for this reason that I believe the cause of the symptoms is the retained waste product of physiological metabolism which we know to be injurious if retained.

A vicious circle is established. The toxins of chronic sepsis by their inhibition of the kidney functions cause a retention of the normal waste products of the body. These waste products are also injurious to the

excretory function of the kidneys when in abnormal concentration in the blood

Nature's endeavor to meet this situation is reflected in the rise in blood pressure. The rise in blood pressure has been found to be among the earliest evidences of the presence of this disease of toxæmia of pregnancy. Irving states in his review of 5000 cases at the Boston Lying-in Hospital that the rise in blood pressure precedes the appearance of albumin twice as often as it follows it.

What is the immediate cause of the rise of blood pressure? Is it the toxins from chronic sepsis or is it the retention of metabolic waste products—or is it the combination of the two? It seems to me that the rise in blood pressure cannot be due solely to the presence of the toxins of sepsis because there are so many instances where we know that the blood is full of toxins of acute disease without a rise in blood pressure.

It is therefore probable that the rise of blood pressure is due to the retained products of metabolic waste either alone or in combination with the toxins of chronic sepsis.

It is generally conceded that the rise in blood pressure is due to stimulation of the adrenal glands and that this rise in blood pressure is a conservative process in endeavor on the part of the system to increase the elimination by bringing more blood to the kidneys in a given space of time.

The rise in blood pressure arising from stimulation of the adrenals is due to a constriction of the peripheral vessels that is an increased resistance to the flow of the blood. This increased resistance must raise the diastolic pressure in the arteries provided that the supply of force from the heart remains the same. This increase in the diastolic pressure must put an increased load upon the heart muscle in order to keep up the normal pulse pressure. In fact unless the heart compensates for this extra load there will be no rise in blood pressure as the heart must be the only source of the arterial blood pressure.

It is at this point that we have the dividing line between two types of toxæmia of pregnancy, the first class being the typical

example where the blood pressure continues to rise in proportion to the amount of toxæmia present which rise is due to the compensation of the heart muscle to the demands made upon it. The second class is less common but a more serious type in which we find evidences of the severity of the toxæmia out of proportion to the elevation of the blood pressure. Such cases may be characterized as those with headaches, dizzy spells, blurring of vision, œdema and albumin and casts in the urine with only a moderate or no rise in blood pressure. This second class of cases is clinically well known as the more serious type. The rise in blood pressure the main object of which is to increase the elimination is what these cases lack. This lack is primarily due to a failure of the heart muscle to respond to the demand made upon it. By failure of the heart to raise the blood pressure and thus increase the elimination the toxins increase in concentration in the blood and do more damage to the liver, kidneys and placenta.

Many cases are reported in the literature of the dental profession as well as of the medical profession which demonstrate the good results obtained in cases of arterial hypertension by removing all foci of infection from the teeth. It has also been recently reported that certain cases of albuminuria have been cured by eliminating chronic sepsis from the teeth. If these reports are true and I am convinced that they are, we have further evidence to corroborate the above theory.

Once it is admitted that a focus of chronic sepsis can cause arterial hypertension or albuminuria it is then necessary to admit that the coexistence of toxæmia of pregnancy and a focus of chronic sepsis is of the utmost importance for is it not these two signs occurring in the presence of a pregnancy on which we base our diagnosis?

Is this theory consistent with the pathological findings in the liver and placenta which are associated with this disease?

The infarct is regarded by many to be the source of the poison which causes the trouble. If we regard the infarct as the result of this poison are not the findings more consistent?

We know that the toxins of sepsis cause an inflammatory reaction in the kidneys. Why

should not this same poison cause an inflammatory reaction in the villous membrane. It should be remembered that this villous membrane is constantly being enlarged throughout pregnancy and that it is on the edge of the placenta that the productive process is going on most rapidly. Every tissue which is in the process of production is in it stage of lowest resistance. It is therefore a tissue which would be more liable to damage from any toxins in the blood. It has been my experience to find most infarcts of any size located on the edge of the placenta and that there is frequently an indentation in the circular circumference of the placenta at this point. This indentation is evidence of the destruction of the villous membrane which prevents its further growth at this point. Is it not reasonable to regard the infarct as an area of villous membrane damaged by toxin in the blood with nature healing process unimpaired.

The central necrosis in the liver found at autopsy is most consistent. Is this not exactly what we should expect to find in view of the theory. The death of the individual represents in acute overwhelming toxemia which the system has been unable to combat. The liver is known to be the great detoxifying organ of the body. If this detoxifying power is overcome it is most natural to expect that that ammonia would be most consistently injured.

To return to the infarct. The occurrence of *interpartum hemorrhage* with toxemia of pregnancy has long been recognized. As I have stated above the injury to the placenta from a toxin in the blood is most liable to occur in its edge. If this damage is sufficient to cause a partial detachment of the placenta at this point it would certainly result in hemorrhage.

Here again the theory is consistent with clinical evidence.

If the above theory is to the etiology of toxemia of pregnancy is correct it is a logical conclusion that we must have a postpartum toxemia of pregnancy as well as a postpartum eclampsia.

I will report two typical cases of postpartum toxemia of pregnancy.

Mrs. P., a 36 year old primipara suffered from postpartum eclampsia. On discharge from the hospital she had a blood pressure of 150 systolic. Five months later she came to me because of shortness of breath, vomiting, headache (severe) and specks before her eyes. She said she had felt perfectly well since discharge from the hospital until about a week ago. Her blood pressure at this visit was 105 and she complained of severe pain in the right epigastrium. While in the office she had a moderate nosebleed. She went directly to the hospital and remained in bed for one week.

Inspection of her mouth showed the following points: Several gold crowns. One lower left molar had inflamed gums. No toothache. On second night in hospital she had severe neuralgia on right side of face and ear. No toothache.

At the end of a week her blood pressure dropped to 110 and the patient felt much relieved. Tender nodes in abdomen gone.

X-ray of her teeth were taken by a dentist who distinctly one of the non-operative kind. He did not take them all and it was only after repeated questions that he admitted that he found anything. The final outcome was the removal of the molar in the lower jaw which the patient had had an awful ulcer on but the dentist informed me that there was not much the matter with it.

Following the removal of the teeth the patient had a few weeks of considerable discomfort having to overcome attacks of epigastric pain with shortness of breath. After the extraction. At the end of the two weeks he reported. Her blood pressure was 100. The urine was negative except for light proteinuria. She said she no longer felt better than before the extraction. Numerous small pustules appeared on her breast and legs. No winged tract on either thigh.

The X-ray examination was very unsatisfactory in this case. It is not complete. Although a tooth was extracted and found on the left side. I am convinced that the still trouble somewhere on the right side in view of the definite neuralgia episode on the right side of her face while she was under observation in the hospital.

The history of the second case of postpartum toxemia is as follows:

Mrs. W., age 27 primipara born in Maryland married 3 years. Family history negative. The patient had hematoma when 8 years old. She has had me quite much trouble with indigestion. Operated upon June 1906 dilatation and curettage for sterility.

The patient came under my observation in December 1906. Her last period was October 1906. Five days before the visit he had a little bleeding which had continued. The patient remained in bed for nearly a week because of intermittent bleeding which was accompanied by considerable nausea and vomiting. There was another slight bleed-

spell in March which quieted down in a few days. The blood pressure and urine remained normal during this period.

From March until the time of delivery nothing abnormal appeared except a rise in blood pressure in June 1917, to 145/90 at which time there were no other symptoms except difficulty in sleeping. For cephs delivery convalescence normal.

Three months after delivery I was called on account of a return of epigastric pain, stiffness of joints and indefinite feeling of lassitude.

Blood pressure was found to be 145/100. Inspection of teeth revealed nothing except one gold crown. A complete X-ray of the teeth was recommended and although the patient denied any symptoms from them five pus cavities were revealed, the largest at the root of the gold crown tooth. Treatment of the teeth has not yet been completed.

I am convinced now that the evidence of chronic sepsis at the roots of five teeth has been established, that the difficulties which she experienced in the early part of her pregnancy, that is the bleeding and gastric upset, were probably due to the toxins of this chronic sepsis. Note the rise of blood pressure which occurred in June. Here we have a sufficient rise to suspect a beginning toxæmia.

Assuming that this theory on the etiology of toxæmia of pregnancy is the correct one, what does it offer in the treatment of the disease? Up to the present time I have not endeavored to treat this disease by attacking the foci of sepsis in the teeth, and I have refrained for what I believe is a very good reason.

Suppose a woman develops the signs of approaching toxæmia of pregnancy during or after her seventh month. According to the theory this is a declaration on the part of her system that the excretory function of the kidneys is not equal to the demand. I have not felt justified in having the foci of sepsis interfered with. If the tooth is extracted or dental treatment with a view to draining the tooth is instituted, this treatment will necessarily throw more toxins into the system and may thereby inhibit the functional power of the kidneys further with the result of bringing on convulsions or serious toxæmic symptoms.

This view of the situation has been supported to a certain extent in the postpartum treatment of those cases which I have had the opportunity to watch. In one case (Mrs P., cited above) the patient had two weeks of great discomfort from headaches, severe epigastric pain and nosebleeds with a general

feeling of malaise following the pulling of one of her teeth. Another case (Mrs W., cited above) had her blood pressure rise to 150/105 from normal following the pulling of two teeth with pus at the roots.

I do believe however that all cases should have dental treatment immediately following the end of the puerperium. By cleaning up these foci of sepsis before another pregnancy, we can at least practice the principles of prophylaxis and place the patient in a position where she can enter upon another pregnancy without fear of the return of toxæmia of pregnancy with all its dangers to herself and child which that implies.

There are two very unfortunate features in the treatment of this condition: first, the details of the treatment lie in another's hands, and second, the average dentist does not work with the assistance of X-ray examinations. There is too the great disadvantage that completely to eradicate the sepsis from the teeth, the treatment must last for months, which makes it very expensive.

However, if the truth of this theory can be supported by the observation of others to the extent that it shall be accepted, methods of treatment will undoubtedly be forthcoming.

In conclusion I do not wish to imply that the focus of chronic sepsis must necessarily be found in the teeth. I believe that any focus of chronic sepsis, such as a chronic tonsillar abscess and the like, may bring about the same result. A focus of chronic infection draining toxins into the blood stream is the essential condition.

#### SUMMARY

The apparent inconsistency of the clinical evidence that the primary cause of toxæmia of pregnancy with or without convulsions is not in the products of conception and yet the termination of the pregnancy causes an abatement of the symptoms is thus explained.

The immediate cause of the symptoms of the disease is the retention of the normal physiological waste products of the developing pregnancy. The primary cause or the cause of the retention is the inhibitory effect of the toxins of chronic sepsis on the excretory functions of the kidneys.

The increased incidence of this disease in those individuals who have a pre existing chronic nephritis proves the intimate relation between the occurrence of symptoms and the damaged excretory function of the kidneys.

By terminating the pregnancy the main supply of these excretory products is removed. Postpartum eclampsia and postpartum toxemia of pregnancy are caused by an increase

in the inhibition of the functions of the kidney following delivery due to an increase in the percentage of concentration of the toxins of chronic sepsis in the blood thereby causing an exhaustion of the remaining excretory reserve power to a point where the retention of the normal metabolic waste products in the system causes the symptoms of eclampsia and toxemia.

## DIAGNOSIS AND TREATMENT OF CHRONIC DUODENAL OBSTRUCTION

By EDWARD L. KELLOGG, M.D., F.A.C.S., NEW YORK  
D. S. ry G. II pial P less G o-F t i gy P ty l M d IS hool

THE impression seems to be general that chronic obstruction of the duodenum is rare and difficult to diagnose. A great deal has been written on acute post-operative dilatation but with a few exceptions the literature of chronic obstruction consists of reports of cases secondary to ulcer.

Lewis Dwight prior to 1897 made a series of wax casts of the duodenum and in that year reported briefly his findings from a purely anatomical point of view. The casts are still preserved at Harvard and through the courtesy of Dr. Bremner I have had an opportunity to study them.

Only in infants did I observe the C-shaped duodenum of uniform caliber which the anatomies picture. In these cases there was little evidence of the angulation so evident in the adult duodenum. In the adult cases the variation in size and shape was marked. There were however certain anatomical markings uniformly present. The first portion lacked the deep stripe observed over the rest of the duodenum, the mucous membrane of this portion apparently being like that of the stomach. At the junction of first and second portions there was a marked constriction in every case.

The junction of the second and third portions was not always clearly defined but in about half the cases a distinct angulation was in evidence and some of the specimens show a constriction at this point.

The transverse portion varied greatly in length and circumference. Most of them showed a distinct groove on the superior and anterior surface caused by the superior mesenteric artery and beyond this an angulation at the junction with the jejunum. In all these casts the posterior surface of the transverse portion showed a groove due to pressure of the spine alone or spine and aorta together. Some of them showed a fourth ascending portion which was absent in others.

The most important lesson to be learned from this study is that the duodenum is placed at a disadvantage in the matter of drainage and is easily subjected to mechanical interference.

The papers of Anders, Bloodgood, Staveland, Codman and Vanderhoof are worthy of perusal. Bloodgood calls attention to the association of a large prolapsed cecum and short mesentery with dilatation of the duodenum. Staveland reports what appears to be the first case of primary duodenojejunostomy performed in 1910. These papers give one the impression that the condition is obscure and the diagnosis impossible unless made by the X-ray or after the abdomen is opened.

It is my belief that the condition is frequently present and the diagnosis can usually be made by the history and physical examination even in cases in which it is not demonstrated by the roentgenologist.

From my private files I have taken the

following partial list twelve cases treated without operation one case treated by gastro enterostomy two cases treated by gastro enterostomy plus duodenojejunosomy three cases treated by operation upon the cecum and ascending colon five cases treated by division of adhesions eighteen cases treated by primary duodenojejunosomy three cases of viscous circle treated by duodenojejunosomy after gastro enterostomy

I am convinced that this condition has been present in many earlier cases some being relieved by operation or treatment for other conditions while in others the results have been unsatisfactory from failure to recognize this factor in the production of symptoms

#### ETIOLOGY

At the operating table we have learned that the obstruction may involve the first portion of the duodenum only the first and second portions or the entire duodenum

When the first portion only is dilated the junction of the first and second portions is angulated caused by the duodenum being drawn up close to the liver by contraction of mesenteric bands or by adhesions binding together the first and second portions or by gastropnoxis the duodenum remaining fixed In the second group giving dilatation of the first and second portions it has appeared to be the result of adhesions extending from the gall bladder or hepatic flexure of the colon

In obstruction of the entire duodenum I have frequently found the condition described by Bloodgood i e a redundant cecum displaced into the pelvis with a short mesentery at portion of ileum near the cecum In this group I believe the significant factor has been the dropping of the hepatic flexure which causes a straight pull of the distended bowel from the splenic flexure across the point of union of duodenum with jejunum The condition may exist without prolapse of the cecum and the following causes are suggested

Duodenojejunal kink from prolapsed cecum and hepatic flexure prolapse of transverse colon adhesions from cholecystitis ulcer inflammation at duodenojejunal junc

tion constriction of opening in mesentery through which the duodenum passes faulty development of the lower thoracic region gastropnoxis with stretching of the attachment of the second portion of duodenum disease of pancreas

It is certain that frequently a considerable degree of obstruction exists without symptoms the condition being found at operation or by X ray examination

A study of the clinical cases shows two sets of symptoms *toxic and mechanical* In some cases both are present in others one group only

Some of the *toxic symptoms* are usually in evidence i e headache mental depression lack of strength disturbed heart action cold extremities skin eruptions

Headache has been most frequently present It is usually temporal sometimes occipital and is constant or occurs several hours after meals Often it is associated with nausea and may be relieved by eating

The mental depression may be very marked Impairment of vigor is more frequently complained of

The disturbance of heart action may take the form of tachycardia or bradycardia or simple irregularity of action These patients are apt to complain of bilious attacks i e headache nausea and vomiting of bile

*Mechanical symptoms* In obstruction of first portion only the symptoms are those of partial pyloric obstruction without the special symptoms described below due to interference with bile drainage

In obstruction of second and third portions the mechanical symptoms will vary according to the problem presenting If the case is one in which interference is due to a prolapsed cecum dragging on the mesentery we may find periods of comfort so long as the colon is empty but with an attack of constipation the drag of the distended cecum inaugurates an attack This is in my estimation the mechanism of the so called bilious attack

The amount of resistance to back pressure offered by the pylorus will modify the symptoms With a resistant pylorus pain is prominent with a relaxed pylorus regurgitation or vomiting of bile is predominant

I have found two distinct points of discomfort (1) A pain or dull ache just to the left of the median line and slightly above the navel (presumably the duodenojejunal junction) This pain is frequently relieved by deep pressure (2) Pain located to the right of the median line and above the navel extending up under the liver and through to the back It may be colic like (due to peristaltic unrest) or steady and dull (due to distention) often lasting until relieved by vomiting Frequently the patients obtain relief by deep pressure in the median line of abdomen below the navel (presumably by unlocking the duodenojejunal kink)

Belching without fermentation may be a troublesome symptom *Vomiting of bile* may follow the attack of pain apparently the relaxing pylorus giving way In some cases the patient feels something give the pain subsides and vomiting or regurgitation of bile follows Often bile works back into the stomach without pain (incompetent pylorus) and is vomited or regurgitated or may be found if the stomach is washed

#### PHYSICAL EXAMINATION

Haves has taught us to recognize dilatation of the duodenum by the physical examination of the abdomen He writes as follows

Dilated duodenum has been marked by tympanite in the area behind the right rectus muscle to the right of or posterior to the pylus usually between the liver above and the transverse colon below The dilated duodenum is easily mapped out by the employment of percussion with pressure Owing to the kinking of the duodenojejunal junction the duodenum is found to be distended with gas often to six or seven inches in diameter The duodenal intubation is frequently associated with gastric stagnation or retention

Pressure paradox In cases showing a dilated duodenum pressure is made backward and upward for about thirty seconds by the hand placed just below the umbilicus the patient being in a semirecumbent or reclining position It might be thought that this would increase the amount of gas present in the duodenum on the contrary in the type of case we are considering this usually results in the undoing of the duodenojejunal kink permitting the duodenum to empty itself as shown by a relatively dull percussion note or marked diminution in the size of the tympanic area At the same time it is often possible to hear and feel the gas escape as it rushes into the jejunum

The accuracy of this procedure has been questioned but I wish to place myself on record as endorsing his statements Not all cases can be recognized in this way at all times however since the duodenum may not be distended at time of examination or may be obscured by a distended colon or stomach

The X ray reports of duodenal obstruction are lacking in uniformity involvement of the first portion is generally recognized but of the entire duodenum less frequently This is probably due to the fact that the duodenum is in part overlapped by the stomach and is not easily demonstrated except by special technique The procedures suggested by Oumby which seem to help in this demonstration are to massage the stomach vigorously forcing the bismuth into duodenum and to hold the stomach up toward the dome of the diaphragm while the picture is being taken It should be remembered that considerable obstruction may exist without marked dilatation if the pylorus is not resistant and that in the type of kink at duodenojejunal junction due to prolapsed cecum and hepatic flexure a preliminary cathartic may result in a failure to demonstrate the condition

It is my custom to inspect the duodenum in all cases of operation upon the digestive tract and it is my belief that the duodenum should be regarded with suspicion if when the transverse colon is lifted up it can be seen bulging through the lower layer of the mesocolon

#### TREATMENT

The majority of cases do not require surgery They are amenable to the treatment given for enteroptosis or intestinal stasis abdominal support sleeping with foot of bed elevated resting after meals in recumbent position (bed elevated) abdominal massage colon irrigations duodenal intubations mineral oil cathartics rest cure combined with forced feeding

The abdominal support should be applied with a view to lifting up the transverse colon and so liberating the kink The type of support will be like that for gastroptosis varying somewhat according to shape of abdomen

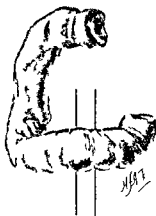


Fig. 1. Waxed Duodenum of an infant

For the thin retracted abdomen the Curtis Lane supporter is the most satisfactory while the pendulous protuberant abdomen can be held up by any belt or binder that produces its maximum pressure just above the pubes and iliac crest. For temporary support the adhesive plaster belt (Achilles Rose) will be found very useful. Sleeping with the foot of the bed elevated 8 to 12 inches is an important therapeutic measure.

By this procedure the drag of prolapsed intestine ceases and the duodenum has an opportunity to empty completely and thus to minimize the infection and irritation.

Resting after meals in the same position is helpful for the same reasons.

In applying abdominal massage the object is to empty the cecum and ascending colon and unlock the kink. I instruct the patients to press the abdomen backward and upward below the navel with the left hand while with the right hand pressure downward is exerted over the duodenum. For the colon pressure is exerted upward on right side transversely at level of navel and downward on the left. A massage ball weighing six or eight pounds will be a great aid in carrying out this treatment successfully.

The rest cure and forced feeding checks the duodenal irritation and infection and diminishes pressure on the duodenum by increasing

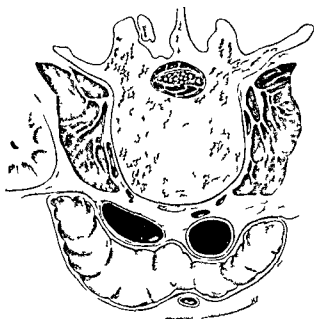


Fig. 2. Frozen section of the human body at the level of transverse portion of the duodenum showing the relation of same to the vertebral column, aorta and vena cava posteriorly and superior mesenteric artery anteriorly. Note the narrow opening of the duodenum here to pass between the aorta and the superior mesenteric artery.

the amount of adipose tissue in the abdomen. Codman has pointed out that fat people have less pressure on the duodenum than thin people for fat in the mesentery distributes the pressure while in thin people the main trunk of the superior mesenteric artery presses the duodenum directly against the bodies of the vertebrae.

Duodenal irrigations furnish a means of combating the duodenal infection and irritation and at the same time help to control the general intestinal toxemia.

#### SURGICAL TREATMENT

The surgical procedure will vary with the cause and degree of obstruction.

In obstruction of the first portion only dividing the adhesions transversely and suturing longitudinally so as to drop the duodenum may be indicated or if stomach is prolapsed the shortening of the gastrohepatic omentum by Beyer's operation relieves the obstruction. In obstruction of the second portion it is usually a problem of treating adhesions.

Involvement of the entire duodenum if not too far advanced and plainly secondary to trouble with the cecum and ascending





Fig 3 Fig 4 Fig 5

Fig 3 shows the internal structure of the ovary, including the corpus luteum and theca interna. Fig 4 shows the internal structure of the fallopian tube, including the uterine tube and the uterine artery. Fig 5 shows the internal structure of the uterus, including the uterine cavity and the uterine artery.



Fig 6 Fig 7 Fig 8

Fig 6 shows the internal structure of the ovary, including the corpus luteum and theca interna. Fig 7 shows the internal structure of the fallopian tube, including the uterine tube and the uterine artery. Fig 8 shows the internal structure of the uterus, including the uterine cavity and the uterine artery.

colon I have been content to relieve the cruse by right sided resection of the colon or plication and anchoring of the same by supporting the stomach and transverse colon (operations of Beyer and Coffey) or by division of the colon.

Gastroenterostomy has been performed but with a better understanding of the condition I consider the procedure obsolete in spite of the fact that the cruse in which I used the method was benefited. When dilatation is marked the operation of choice either alone or accompanied with other indicated procedure is duodenoduodenostomy.

In my series there has been no mortality and in every case there has been either im-

provement or complete relief of symptoms although sufficient time has not yet elapsed to speak definitely of end result.

The procedure is only a little more difficult than gastroenterostomy, the technique is much the same. The point of approach is through the transverse mesocolon to the right of the vertebral column. The duodenum can be easily mobilized by blunt dissection but this is seldom necessary since the dilatation causes it easily to present at point of operation. The convalescence is usually uneventful.

The following cruses are reported briefly as an example of the varying problems which present

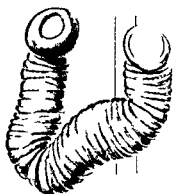


Fig 9

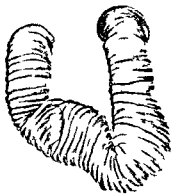


Fig 10

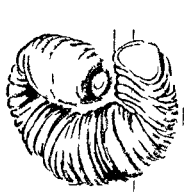


Fig 11

Fig 9 Adult duodenum. Showing a drooping of the second and third portions and an unusually long fourth or ascending portion.

Fig 10 Under surface (Fig 9) shows artificial groove caused by aorta. This is present in every case. It may

be artificial due to injury of the aorta but is suggestive as a possible point of pressure.

Fig 11 Adult duodenum. Shows dilatation of the first, second and third portions apparently due to exaggeration of the superior mesenteric groove.



Fig 12



Fig 13



Fig 14

Fig 12 Adult duodenum. The first point of contraction is the pyloric ring. The first portion of the duodenum shows marked dilatation due to contraction at the junction to the first and second portions. Second and third portions are dilated due to contraction at the extreme left of the third portion. The cause of this is not clear as it is beyond the notch made by the superior mesenteric

artery. Probably the anastomosis at the junction with the jejunum is reliable.

Fig 13 Adult duodenum. An unusual case. The second, third and fourth portions are contracted and tend to the left of the aorta farther than usual.

Fig 14 Adult duodenum. Interesting because of its peculiar shape but particularly because of its

CASE 1 T J L male age 30. Present illness commenced five years ago. The patient had violent epigastric pain one half hour after meal. Duration short, sometimes a second attack one and one half hours after meal. Often wake up with pain from 11 p.m. to 1 a.m. Sometimes eating gives relief.

Examination shows tenderness to pressure over the epigastrium and at point to left and slightly above umbilicus and at hepatic flexure. The duodenum is apparently dilated but this was not demonstrated with certainty. No blood was found by any of the clinical methods.

The x-ray disclosed ulcer and adhesions of duodenum. An operation was performed for duodenal ulcer.

Pathology. A small indurated ulcer was found on the duodenal side of the pylorus. The pyloric ring being partially occluded. The duodenum was

considerably dilated being visible three fingers breadth below the transverse mesocolon when the colon was drawn out of the wound. The jejunum was fastened to the under surface of the mesocolon by a long ligament of Treitz.

Operation. Inferior gastroenterostomy and duodenojejunostomy. The latter procedure was undertaken with the feeling that the dilated duodenum would predispose to a vicious circle unless it was drained. Convalescence was uneventful and cure appears to be complete.

CASE 2 M B female age 21. For six months the patient has complained almost daily of colic in upper abdomen to right of navel extending up under liver and through to back. The pain has no relation to the taking of food but is worse when patient is constipated. Physical examination shows cecum movable and distended with gas. Duodenum dilated on percussion upward pressure below trans



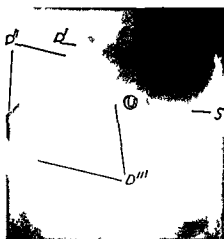


Fig 18

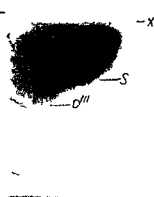


Fig 19

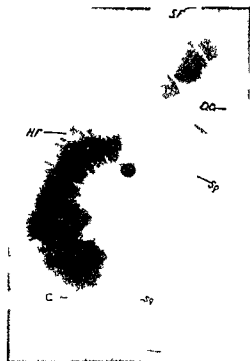


Fig 20

Fig 18 Case of Mr. W. Stomach marked S. The position of the content of the duodenum marked D. The pressure of the hand also displaces the duodenum slightly to the right.

Fig 19 Case of Mr. W. Stomach and duodenum in normal position. The patient erect. The stomach contents are exhibited as a pool of which the upper margin is marked X. The contents of the duodenum D form a pool

at a slightly lower level than the upper margin of which is marked I. It extends below and beneath the latter curvature of the stomach.

Fig 20 Case of Mrs. W. After administration of castor oil the position of the caecum marked C and the drop of the hepatic flexure marked III pre-disposed to duodenal obstruction (Figs 18 19 and 20 refer to Cases reported above).

bitter. There has been no retention vomiting. Constipation is marked. He has lost 20 pounds.

**Examination.** The caecum is dilated and there is diminished resistance in the right iliac fossa. The stomach is slightly distended. There is moderate tenderness in the region of the pylorus. The duodenum is dilated. The stomach contains hydrochloric acid in excess and empties slowly after motor meal. Fasting stomach empty. There is occult blood in the feces and repeated thread tests show blood stain on duodenal portion of thread. X-ray examination shows penetrating ulcer in first portion of duodenum.

**Clinical diagnosis.** duodenal ulcer, dilated duodenum. **Operation.** October 4. **Pathology.** The caecum is dilated and adherent to the abdominal wall. There is a small indurated duodenal ulcer just beyond the pylorus. The pylorus is not obstructed. The duodenum is very much dilated apparently due to inflammatory thickening and narrowing of jejunum.

Duodenojejunostomy was performed since in my judgment the duodenal obstruction was responsible for the ulceration. (Had gastroenterostomy been performed it would have been necessary to do a pyloric exclusion and the obstruction of the duodenum would have remained.)

Recovery was uneventful and complete.

So far as I can learn this is the first recorded case of duodenojejunostomy for duodenal ulcer.

**CASE 3.** Mrs. H. W. W. age 30. Three years ago the patient had an operation for appendicitis and floating kidney. The symptoms were relieved for two months. Following this she had a series of attacks described as follows.

**First attack.** Woke up at night with severe pain across the upper abdomen extending up under the sternum. The pain was so severe that she thought she would go insane. Temperature was subnormal.

**Second attack.** Onset after swimming preceded by three or four days of depression and constipation. Severe pain in same location but not cramp-like. She felt faint and her palor was marked. The pain was constant for a month. No vomiting temperature was subnormal.

The third attack followed overexertion. It was cramp-like with vomiting and lasted two weeks with temperature normal. Following onset she had a dull pain and soreness through the right side of the upper abdomen.

Fourth attack came on a week ago following a cold sudden violent cramp-like pain in the same location. There was no vomiting or faintness. The pain came about two hours after breakfast.



# DEPARTMENT OF TECHNIQUE

## INFECTION OF A FUSED KIDNEY WITH DUPLICATION OF THE LEFT RENAL PELVIS<sup>1</sup>

BY IEO BUEHRER M.D. F.A.C.S. NEW YORK

IN recounting the history and clinical course of a very interesting case of renal infection occurring in a kidney with a double pelvis it is my purpose to discuss some interesting points in the diagnosis of surgical renal disease and also to bring to your notice the importance of a thorough knowledge of the existence of renal anomalies a study of which may aid both in making exact anatomical diagnoses and in the selection of subsequent operative intervention.

The frequency of the incidence of renal anomalies is well known to the urologist. Not enough, however, has been written concerning the occurrence of infections in anomalous kidneys to acquaint the surgeon with the importance of an accurate diagnostic exploration of the function of the anomalous as well as of the sister organ for the technique of nephrectomy if it becomes necessary may be more safely carried out and the indications for operative intervention more accurately planned if such precise knowledge is at the surgeon's disposal.

In presenting below a case of duplication of the renal pelvis with duplication of the ureter complicated by calculi and infection I feel fortunate in being able to discuss clinical manifestations and cystoscopic and X-ray findings that should prove instructive and interesting both from a pathological and diagnostic viewpoint.

Above all the case to be analyzed will emphasize the value of the combined roentgenographic and cystoscopic methods as a reliable and almost necessary prelude to the operation of nephrectomy when such is indicated for severe infection of one half of a kidney with a double pelvis.

Large vesical calculus cystitis duplication of the ureter and pelvis of the left kidney pyelitis pyelonephritis multiple renal abscesses perinephritis calculi in the pelvis of the upper portion of the left kidney with a second normal ureter and corresponding pelvis occupying the lower pole.

M. N., age 38, male, consulted me on December 28, 1917, with the complaint that he had had urinary symptoms for about 10 years, there being a distinct diminution in the size of the urinary stream during that period with one attack of retention of urine. Two years ago he was told that he had a urethral stricture which required dilatation; this method of treatment having been regularly given for some time apparently without relief. During a six weeks' period of such treatment there were occasional attacks of chills and fever, frequency of urination, nocturia and sticking pains in the left hypochondrium radiating down into the left iliac fossa. Altogether he seemed to have suffered for about three months after his symptoms began two years ago. The symptoms then gradually subsided and the urgency and nocturia disappeared so that he seemed to feel quite well.

About four months previously, in September, 1917, he again noticed a diminution in the size of the urinary stream, a decided increase in urinary frequency—voiding bloody urine twice a night—and with cutting pain in the bladder region and tip of the penis during the entire act of micturition.

In short, he presented a history of stricture of the urethra with one attack of retention two years ago, complicated by chills and fever during the period of dilatation with sounds and evidences pointing to infection of the left kidney, then again four months ago a return of symptoms at which time he sought the advice of a physician.

X-ray examination revealed a vesical calculus which on some of the plates had a spherical outline ( $\frac{1}{3}$  inches in diameter) but in a second set of plates taken December 29, 1917, had an elliptical shape ( $2\frac{1}{2} \times 1\frac{1}{2}$  inches in diameter—Fig. 1).

In the region of the left renal area over the eleventh and twelfth ribs there was an irregular sausage or kidney shaped shadow suggesting the presence of more than one calculus and measuring  $1\frac{3}{4}$  inches in length by  $\frac{3}{4}$  inches in width. The renal shadow indicated a considerably enlarged organ.

The patient has been the cause of her  
gas moving about in the region of upper  
abdomen. She is not eating but cannot  
The symptoms are the same as in  
are not fully food. The symptoms are fully  
subside but keep her from sleeping  
in the early part of the night.

On admission the condition is not  
for eight days but only in the morning  
after a night of sleep. The condition is  
the same as in the morning. The condition is  
only a little better. The condition is

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diagnosis can usually be made from the  
history and physical examination and may  
be confirmed by an X-ray examination when  
special technique is employed. An X-ray  
examination often fails to demonstrate it  
even when present to a marked degree.

A majority of the cases are amenable to  
medical treatment. Those not responding  
can be cured by a surgical procedure which  
will vary according to the etiology of the  
case: dividing adhesions or shortening the  
gastrohepatic omentum for obstruction of  
first portion; dividing adhesions for obstruc-  
tion of second portion; Duodenojejunotomy  
usually meets the indications for obstruction  
of the third portion or some operation on the  
cecum and ascending colon when the con-  
dition is plainly secondary to a drag of the  
prolapsed bowel and dilatation is not ex-  
cessive.

The following suggestions are offered:

Acute postoperative dilatation of the duo-  
denum is usually preceded by a chronic con-  
dition and may be prevented by correcting  
the latter. A vicious circle after gastro-  
enterotomy is due to duodenal obstruction  
already present or produced by the operation.

In performing gastroenterostomy if the  
duodenum is dilated a duodenojejunotomy  
should supplement the procedure. Many so-  
called bilious attacks may be caused by  
obstruction of the duodenum following con-  
striction and the drag of a prolapsed cecum.  
Chronic duodenal obstruction probably pre-  
disposes to duodenal ulcer. In operation for  
duodenal ulcer when the pylorus is not  
obstructed and the duodenum is dilated  
duodenojejunotomy is the proper surgical  
procedure.

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#### CONCLUSIONS

Chronic duodenal obstruction frequently  
occurs sometimes as part of a general in-  
testinal stasis but also independently. The

# DEPARTMENT OF TECHNIQUE

## INFECTION OF A FUSED KIDNEY WITH DUPLICATION OF THE LEFT RENAL PELVIS<sup>1</sup>

BY IEO BLERGER MD FACS NEW YORK

IN recounting the history and clinical course of a very interesting case of renal infection occurring in a kidney with a double pelvis it is my purpose to discuss some interesting points in the diagnosis of surgical renal disease and also to bring to your notice the importance of a thorough knowledge of the existence of renal anomalies a study of which may aid both in making exact anatomical diagnoses and in the selection of subsequent operative intervention.

The frequency of the incidence of renal anomalies is well known to the urologist. Not enough, however, has been written concerning the occurrence of infections in anomalous kidneys to acquaint the surgeon with the importance of an accurate diagnostic exploration of the function of the anomalous as well as of the sister organ for the technique of nephrectomy if it becomes necessary may be more safely carried out and the indications for operative intervention more accurately planned if such precise knowledge is at the surgeon's disposal.

In presenting below a case of duplication of the renal pelvis with duplication of the ureter complicated by calculi and infection, I feel fortunate in being able to discuss clinical manifestations and cystoscopic and X-ray findings that should prove instructive and interesting both from a pathological and diagnostic viewpoint.

Above all the case to be analyzed will emphasize the value of the combined roentgenographic and cystoscopic methods as a reliable and almost necessary prelude to the operation of nephrectomy when such is indicated for severe infection of one half of a kidney with a double pelvis.

Large vesical calculus cystitis duplication of the ureter and pelvis of the left kidney pyelitis pyelonephritis multiple renal abscesses perinephritis calculi in the pelvis of the upper portion of the left kidney with a second normal ureter and corresponding pelvis occupying the lower pole.

A 38 year old male consulted me on December 28, 1911, with the complaint that he had had urinary symptoms for about 2 years, there being a distinct diminution in the size of the urinary stream during that period with one attack of retention of urine. Two years ago he was told that he had a urethral stricture which required dilatation this method of treatment having been regularly given for some time apparently without relief. During a six weeks period of such treatment there were occasional attacks of chill and fever frequency of urination nocturia and sticking pricks in the left hypochondrium radiating down into the left iliac fossa. Altogether he seemed to have suffered for about three months after his symptoms began two years ago. The symptoms then gradually subsided and the urgency and nocturia disappeared so that he seemed to feel quite well.

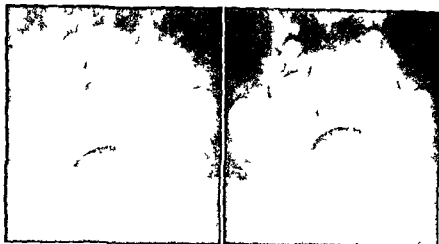
About four months previously in September, 1911, he again noticed a diminution in the size of the urinary stream, a decided increase in urinary frequency—voiding bloody urine twice a night—and with cutting pain in the bladder region and tip of the penis during the entire act of micturition.

In short he presented a history of stricture of the urethra with one attack of retention two years ago complicated by chills and fever during the period of dilatation with sounds and evidences pointing to infection of the left kidney then again four months ago a return of symptoms at which time he sought the advice of a physician.

A ray examination revealed a vesical calculus which on some of the plates had a spherical outline ( $\frac{1}{2}$  inches in diameter) but in a second set of plates taken December 9, 1911, had an elliptical shape ( $2\frac{1}{2} \times 1\frac{1}{2}$  inches in diameter—Fig. 1).

In the region of the left renal area over the eleventh and twelfth ribs there was an irregular sausage or kidney shaped shadow suggesting the presence of more than one calculus and measuring  $1\frac{1}{2}$  inches in length by  $\frac{3}{4}$  inches in width. The renal shadow indicated a considerably enlarged organ.





I t a l I l l t i l l t l l l t

the hospital with practically no disturbances of micturition but showing the distinct signs of severe attacks of pyelonephritis. He did not appear strong and healthy and recurrences of attacks of pyelonephritis were considered extremely likely and in fact were to be expected.

On February 25 1917, he again came to the office for an opinion having noticed that he did not build up but had become progressively weaker. He was referred to the Mt Sinai Hospital for a thorough investigation of his urologic status.

The patient was admitted to the Mt Sinai Hospital on February 2 with a temperature of 101 no renal tenderness a haggard look and urine containing a fairly large amount of pus. It was again a question as to whether the temperature was due to the infection of the left kidney without local manifestations or whether some intercurrent or other infection such as tuberculosis was present.

On February 8 1918 another cystoscopic examination was performed to determine whether we were dealing with retention of purulent urine in the kidney or not. At this time it was easy to obtain a perfectly good view of the bladder because the stone had been removed and the mucous membrane was found almost normal except for some congestion. It was with surprise that *two ureters were discovered* on the left side the upper or posterior one doubtlessly having been covered up by the large calculus at our previous cystoscopic examination. All three ureters were catheterized specimens being obtained from the right kidney and from the upper or posterior and lower or anterior ureteral orifices on the left side. A roentgenogram with two shadowgraph catheters one in each left ureter was then taken giving the picture seen in Figure 2. The urinary report was as follows:



Fig. 2. Two shadowgraph catheters one entering each pelvis; calculi in upper pelvis.

Desirous of studying the relationship of the two left ureters to the composite left renal mass two shadowgraph catheters were placed into the two left ureters on February 8 after the urine had been collected and a plate taken.

On this X-ray plate the course of the two ureters was well outlined their paths overlapping just below the pelvic brim and again crossing or being superimposed at about the level of the fourth lumbar vertebra. The relationship of the calculi to the two ureters could also be deduced from these two plates it being readily seen that they occupied the upper pelvis and the ureteropelvic junction. From these plates too the well known fact that the upper or posterior ureter usually enters the lower pole whereas the lower or anterior ureteral orifice leads to the upper pole was found to be substantiated.

On February 28 at about the time that the cystoscopy was done the temperature had already risen to 103 and at 4 p.m. was 104.2. The palpation of the left hypochondrium and left lumbar region gave evidence of an enlargement of the kidney without any local tenderness.

The temperature remained fluctuating between 102 and 103.8 until March when it gradually came down to 102 and on March 3 did not rise above 99.2.

On March 4 the temperature was again 100 and by this time we were fairly certain from our investigations that no other focus was responsible for the temperature.

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		mm	mm

To summarize we have a fairly normal functioning right kidney with urine containing a trace of albumin a left kidney containing two pelvis the lower pelvis corresponding to the upper ureter presumably normal except for the presence of bacillus coli communior in culture and an upper pelvis evidently infected with urine containing many pus cells diminished ureter output and infected with bacillus coli communior.

Thus we were dealing with a man who had had recurrent attacks of pyelonephritis in a kidney with a double pelvis the lower portion of which was evidently healthy the other or upper portion harboring one or two calculi and the seat of an extensive pyelonephritis.

**Diagnostic conclusions.** In a man who had had a large vesical calculus and in whom the X-ray findings indicated the presence of a fur sized calculus in the left kidney the clinical course as well as the cystoscopic findings pointed to every infection of it kept the upper half of the left kidney the lower pelvis being uninvolved. The insidious nature of the process evidenced by the absence of local pyelonephritic or local tenderness the presence of attack of fever with general symptom rather than localizing phenomena made the interpretation of the clinical course and the surgical indications somewhat difficult. However from a consideration of the findings it was possible to make the following deduction regarding the anatomic lesion present.

Thus we surmised that the upper portion of the kidney was the seat of an inflammatory process with multiple abscesses or at least extensive pyelonephritis and suppurative areas in the parenchyma and furthermore because of the long history and the absence of a true pyonephrosis (as indicated by cystoscopic findings) and the absence of pain and tenderness we were in all probability dealing with an inflamed kidney whose exterior was enveloped in markedly thickened perirenal adipose tissue that is a kidney surrounded by enormous fat production and enveloped as it were or encased in a mass of inflammatory tissue.

The operative findings corroborated this diagnostic inference in revealing a kidney that corresponded almost exactly to that which we had expected to find.

**Operation May 1, 1915.** The right ureter was ligated and the left kidney was exposed by dividing the large left meso-epididymal ligament and the broad ligament. The lower pole of the kidney was never appeared to be normal. The two ureters

were exposed with little difficulty the lower one being normal the upper one thickened about the diameter of the small finger. The halves of the kidney as well as the upper pole seemed to be paracalcularly arranged and surrounded by large masses of adipose tissue and inflammation. The upper pole could be palpated. After the upper portion of the kidney had been freed a lithic ureter cut across it and exposed that the lower pole as well as the isthmus of renal sinus which apparently crossed the lumbar vertebral column. When traction was made upon it the fusion between the lower pole and its renal organ could be easily demonstrated the connection being present in the form of a fan-like renal tissue about one and one-half centimeters in diameter.

The isthmus then divided between clamp and uterine thread the lower normal ureter cut through and the kidney removed.

**Findings.** The kidney is almost entirely normal in size the upper portion being enlarged in a mass of adipose tissue. The lower pole from 3 millimeters to 1 centimeter in length and 1.5 centimeters in diameter. The upper pole also enclosed in a large amount of inflammatory fat the ureteropelvic junction and the pelvis just above the point of union by reason of the presence of a calculus in the upper pelvis. The upper ureter very much thickened and inflamed. It all retracted at least four times the normal size. That portion of the cortex of the upper portion of the kidney that is thin though the capsule is entirely plethoric the parenchyma at the lower pole is almost a normal appearance. Somewhere between the third and three-fourths of the length of the upper pole was diseased from a mere surface inspection half about one-fourth of the lower pole appeared to be normal.

On section (Fig. 3) is evident that the upper half of the kidney is the seat of an extensive inflammatory process that involves particularly the parenchyma of its upper half. Here there are the typical signs of pyelonephritis with streaks of purulent matter arranged in the typical triangular or pyramidal shape extending downward through the capsule. The capsule is so enormously thickened around the hard septa at the periphery of the thick mass of perirenal inflammation. The pelvis of the upper portion of the kidney is slightly dilated thickened and inflamed and harbors two calculi which almost completely fill the ureter pelvis junction and the distal portion of the pelvis. These measurements of one and one-half inches in length by one and one-fourth inches in diameter.

The lower normal portion of the kidney occupying the lower pole provided the small pelvis that lead into the lower ureter both being practically normal.

The patient made an uninterrupted recovery.

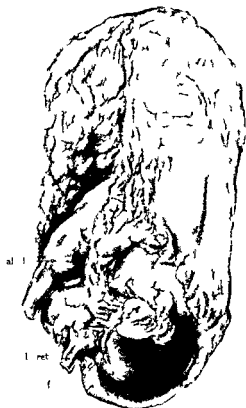


FIG. 3. Deposition of inflamed fat about the upper two thirds of the kidney enlarged upper ureter normal lower ureter normal lower pole with cut surface through the isthmus

his general condition improving immediately so that he was up and about on the twelfth day and ready to leave the hospital during the third week after the operation

#### CLINICAL DEDUCTIONS

A consideration of this most instructive case will disclose points of interest on the interpretation of clinical symptoms concerning the application of cystoscopic diagnosis regarding the importance of combined X ray and cystoscopic methods and finally about the technique of nephrectomy when cases of this sort are subjected to operative intervention

1. *The interpretation of the clinical symptoms* Very illuminating in this case was the association of attacks of fever with evidences of infection of one kidney without however the presence of any localizing sign either in the form of spontaneous pain or local tenderness. At one time even the absence of a large kidney was noted and it was not until later in the course of the disease that the

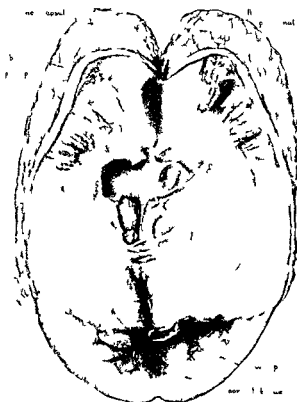


FIG. 4. Kidney bisected showing perirenal inflammatory fat two stones in upper pelvis with multiple abscesses inflamed oedematous upper three fourths of parenchyma and normal lower pole

left kidney became appreciably enlarged and palpable. That such attacks of fever without localizing signs can give cause for anxiety on the part of the clinician is very evident particularly so if a thorough investigation of the urinary tract is not carried out. Thus in the absence of a cystoscopic and roentgenographic examination with the mere presence of pus in the urine it can be readily understood how the kidney as a causative factor in the production of the clinical picture could be overlooked. In the explanation of the absence of costovertebral tenderness or pain we may suggest the following hypothesis that because of the enormous production of perirenal fat and of the encasement of the infected portion of the kidney in a mass of inflamed fatty tissue and connective tissue the inflammatory process was as it were encapsulated and prevented from producing fresh exacerbations of perirenal inflammation. It appears that only thus could we explain the absence of localizing pain. Then too the absence of

any considerable retention of secretion in the pelvis of the kidney could be held accountable for the dearth of symptom. We are warranted in concluding, therefore, that if the cystoscopic and X-ray findings definitely point to the existence of a severe or well marked renal infection, the absence of local pain suggests at least the possibility of such an encroachment of the inflammatory focus as we present in the case.

*The application of the cystoscopic method of diagnosis.* Here, par excellence, we had a case in which value of careful cystoscopy both in studying the indications for peritonectomy as well as in making an exact anatomical diagnosis of the existing condition was well exemplified. Thus it enabled us to make a diagnosis of the existence of two ureters, to determine that only one pelvis was infected, to decide as to which pelvis was infected, to determine the upper or lower by the means requiring valuable suggestion as to the manipulation necessary at the time of operation.

*The importance of combined cystoscopic and X-ray examination.* Since the study of renal and ureteral anomalies teaches us that in the presence of a double ureter with duplication or bifurcation of the pelvis we must be suspicious of the presence of a fused or horseshoe type kidney, it is important to know not only the course of the duplicated ureter but also to be able to trace the path of the normal ureter with a view to deciding as to whether it leads into a normal kidney over a normal path or whether it takes a more medial course where it might be injured at the time of operation.

We may anticipate by saying that it is advisable in all operative cases where three ureters are present to outline these with shadowgraph catheters and to attempt by good roentgenograms to demonstrate the existence of a renal shadow on the supposedly healthy side in order to determine whether this is sufficiently large to permit of nephrectomy of the diseased organ should such procedure be indicated.

Thus the two ureters on the one side may not take a parallel course but one of these may cross over the spinal column and lead into the other supposedly healthy kidney, a

fact which is important to know. Second there may be only one kidney present a fused kidney, the ureters having their vesical orifices in their normal position or third there may be a solitary kidney with all three ureters leading into one possibly elongated but unilateral mass. Hence the importance of visualizing a renal shadow on each side as well as of outlining the ureter.

The demonstration of the path of the healthy or normal ureter is equally valuable for two reasons: first because it may be impossible on account of the stoutness of the patient to obtain a satisfactory outline of the supposedly healthy kidney and second because we might very easily injure the ureter of the healthy organ were it to take an abnormal course and traverse the lumbar column dangerously near the field of operation.

In short in every case of three ureters requiring operative intervention on one kidney, it is advisable to demonstrate the course of the three ureters by means of shadowgraph catheter. Such plates are of more value when there are three ureters than when there are four because in the case of four ureters a symmetrical disposition is more likely than in the case of three. In a case of four ureters we may expect two on each side leading into discrete kidneys with double pelvis or two ureters on each side leading into symmetrically placed portions of a fused or horseshoe kidney. It is in the cases of three ureters that chance of asymmetry is greater and that the course of the third or normal ureter needs visualization.

4. *The value of demonstrating the shadow of the healthy kidney.* Not only may this suggest or rule out horseshoe kidney but it may also give us valuable information as to the size of the organ and therefore some indication of its functional capacity.

Abnormal or enlarged renal outline attended with a normal urinary secretion (as evidenced by ureteral catheterization) means that the chances for recovery in the event of nephrectomy of the other organ are better; it means in all probability that adequate parenchyma for sustaining life is present and it indicates that a severance of an isthmus —

in the event of renal fusion—would be a relatively easy matter

#### SUMMARY

The following instructive points may be learned from a study of our case

1 That when a large calculus lies in the bladder catheterization of both ureters may be possible particularly if the stone be pushed aside by means of the beak of the cystoscope but that a double ureter on one or the other side may be overlooked the posterior or upper one being covered by the calculus

2 That infection may occur in one of the pelves of a kidney with ureteral duplication without involving the parenchyma corresponding to the other pelvis

3 That cystoscopic diagnosis is of great importance even though the X-ray examination may show a calculus for it permits of an exact anatomical diagnosis and enables us to diagnose a double pelvis and ureter if such be present giving us thereby valuable hints as to the technique of nephrectomy

4 That the presence of a ureteral and pelvic duplication should make us suspect the existence of a fused kidney although such cannot always be diagnosed with certainty

5 That a knowledge of the possible presence of a fused kidney at time of nephrectomy is important in that it not only suggests to us the search for the existence of a con-

nection isthmus but also induces us to avoid injuring the ureter of the other kidney

6 That whenever a double pelvis is present with two ureters it is interesting not only to outline these two by means of the shadowgraph catheter but also to obtain by means of the shadowgraph catheter an outline of the third ureter and if possible to obtain a shadow of the normal kidney The outline of the two ureters on the one side helps us in the technique of nephrectomy and the course of the normal ureter is of importance to us in that it spells safety for us if its course is normal whereas it should be dealt with with great care if the normal ureter be situated far mesial or overlying the isthmus of a horseshoe or fused organ

7 That the occurrence of attacks of fever sometimes with chills means pyelonephritis and multiple abscesses in the absence of evidences of marked retention of urine in the kidney

8 That the absence of local lumbar or costovertebral tenderness in a case of pyuria with attacks of fever and chills with cystoscopic evidences of unilateral renal infection does not mean an absence of severe renal infection but that it indicates an associated *intense perinephritis* with enough fat production to form a large massive shell about the infected kidney the suppurating parenchyma being walled off thereby to such an extent that the usual symptoms do not manifest themselves

# THE EXTREME PENDULOUS ABDOMEN AND ITS SURGICAL TREATMENT BY A NEW THREE FLAP OPERATION

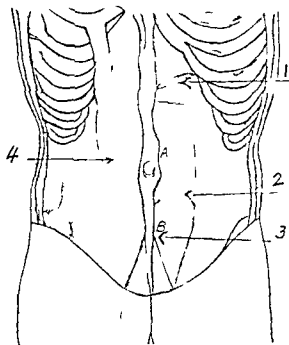
BASIL JOHN M. LIAN, M.D., M.R.C.S. (L.), F.A.C.S., W. I. G. CANADA  
W. P. C. 1118-1

**T**HE surgical treatment of the pendulous abdomen is still in the evolutionary stage. One look in any reference to the subject in the ordinary textbook and but very brief mention is made in the more extensive system of surgery than many excellent articles by Alexis McClellan, Cullen, Wayne, Babcock and others have appeared in the recent issue of the surgical journal. I need mention should be made of the work of Black in level pinning the double flap operation and of W. J. May operation for umbilical hernia with procedure having their place in the treatment of much of the large type of the condition under the category of pendulous abdomen usually seen in women who have gone through repeated pregnancies in whom the panniculus adiposus especially well developed. Modern methods of treatment hit and miss the ideal of minimizing

the lower abdominal rather than giving support thereto tend to aggravate the condition.

## ANATOMICAL CONSIDERATIONS AND PATHOLOGICAL ANATOMY

Anatomical reasons for the condition are found in the arrangement of the aponeurosis of the linea alba. From one and one half to two inches above the symphysis pubis where the rectus muscles decussate and are reinforced by the triangular fascia of the abdomen and the pyramidal muscle the wall at this point is extremely strong. In no case was the stretching of the linea alba found to have passed below this point. At a point immediately above the umbilicus the linea alba appears to be very dense and unyielding. In all the cases observed a well defined line of demarcation existed between the stretched part and the part above the umbilicus which had not given way. This point appears to be at the lowest linea transversa of the rectus muscle and is situated just above the umbilicus. The point of



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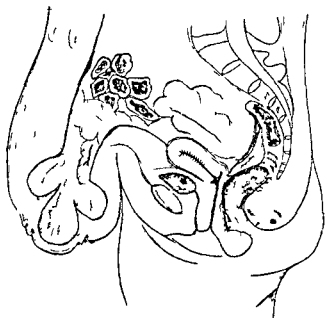


Fig 3 Extreme pendulous abdomen with umbilical hernia. The umbilicus forms the apex of the protrusion.

maximum lateral stretching in all the cases seen by me was at the semilunar folds of Douglas. The recti muscles are displaced and while in some cases somewhat attenuated do not enter into the parts that have given way.

According to Cunningham<sup>1</sup> the umbilicus is situated normally below the mid point between the infrasternal notch and the symphysis pubis. It is opposite the fourth lumbar vertebra. In most of the cases referred to in this article it was opposite or below the symphysis pubis.

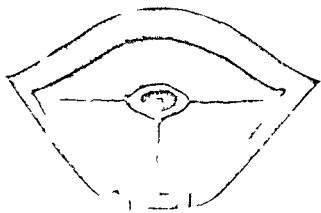


Fig 5

Fig 5 Total circumference and net circumference. a and m are the points of measurement.

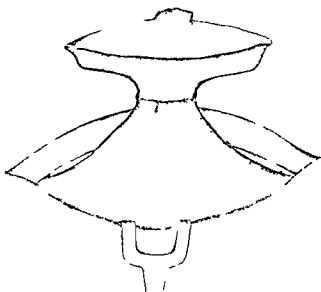


Fig 4

Fig 4 Elliptical incision. That directed from external oblique aponeurosis, related abdominal wall lifted up in form of a cone.

If an opening is made at the umbilicus and the hand inserted into the abdomen of one of these huge pendulous cases a definite internal ring can be felt which might be compared to the internal ring of an ordinary hernia. This ring is bounded laterally by the margins of the recti muscles below by the point of decussation of the recti.



Fig 6

Fig 6 The internal ring is here hardly for stit in.





Fig 5

The patient is a woman, 35 years of age, who has been suffering from a large, rounded, protruding mass on the right side of the abdomen for several years. The mass is about 10 cm in diameter and is composed of a large, rounded, protruding mass on the right side of the abdomen.

muscle at the level of the half inch above the pubic margin of the linea alba which has not yielded to the traction of the rectus abdominis muscle.

It will therefore be seen that while at first light the traction of the structure appears to be universal to the whole anterior abdominal wall it is entirely limited to a definite area. This area in the normal anatomical position is a narrow line the linea alba and that part of it lying between a point very little above the umbilicus and a point at the level of a half to two inches above the symphysis pubis (Fig 5).

#### URGICAL TREATMENT

Surgical treatment should not be lightly undertaken and is called for only when the condition is causing trouble some symptom. The operative mortality has been high in the type of patient. McGinnis in 1912 placed it at 6 per cent for massive non-translated and 50 per cent for massive



Fig 6

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translated hernia. The evidence only conveys a relative idea of the mortality for we do not know what type of operation was done or whether anything was done beyond a simple umbilical hernia operation without any attempt at reducing the protruding abdominal wall. The cases become complicated but must necessarily be those associated with an umbilical hernia as obviously it would be difficult to have an obstruction in a pendulous abdomen not accompanied by an umbilical hernia.

The preparation of the patient for operation in these cases is most important for two reasons. First because the intra-abdominal pressure should be reduced to a minimum and second the skin which is moist and foul from intertrigo must be cleaned and purified. For a week or ten days the patient should be put on purgation and a very restricted diet. Daily warm baths should be given and alcohol applied to the skin of the abdomen. A folded sterile towel should be placed between the overhanging abdomen and the pubes and kept in place by a narrow binder or bandage



Fig 7 C

Fig 7 C

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Fig 7 C se

which falls into the crease and over which the towel folds. This should be worn during the preparation to prevent the two skin surfaces coming in contact with each other.

**Operation.** The pendulous abdomen due entirely to an abnormal development of the panniculus adiposus where the muscular and aponeurotic structures are normal (Fig. 2) rarely calls for treatment and if it does a simple lipectomy is all that is necessary.

In one case referred to me by Dr. H. P. H. Galloway, suffering from sacroiliac strain, a lipectomy was done to facilitate the fitting of an orthopedic apparatus for the support of the strained sacroiliac joints. This type of pendulous abdomen may be associated with an umbilical hernia in which case a Mayo operation combined with a lipectomy is indicated. These types are not to be confused with the type of extreme pendulous abdomen where there is marked diastasis of the recti muscles and where the linea alba is greatly stretched. Their recognition and differentiation should not be difficult.

The following procedure which I have named the three flap operation is I believe the method of choice when operative treatment is undertaken in the case of extreme pendulous abdomen (Fig. 3). Two long incisions forming an ellipse are made from one side of the abdomen to the other, the upper passing above the umbilicus, the lower passing about two inches above the fold where the abdomen hangs over the pubes. The skin and fat are dissected away from the external oblique aponeurosis until the ring of the umbilicus is met (Fig. 4). The abdomen is then opened at the umbilicus and the mass dissected away from the umbilical ring. Great care must be taken at this point as the umbilicus is often dilated into a multilocular sac and the contained omentum and intestines are often adherent. It will now be found that the part of the abdominal wall which has given way can be lifted up in the form of a cone with the umbilicus forming the apex (Fig. 4). If the fingers be inserted within this cone the internal ring already described can be felt at its base.

It will serve the purpose for the convenience of description to call this the internal ring of the protrusion. The upper limits of the ring while several inches from the umbilicus in the pendulous abdomen cases is a point very close to the normal anatomical position of the umbilicus and as already mentioned corresponds to the lowest linea transversæ of the recti muscles.

Two lateral incisions are now made from the umbilical ring to the inner margins of the recti

muscles. A third incision is made from the umbilical ring downward to the firm lower margin of the internal ring, the point already described where the recti muscles decussate (Fig. 5). Three flaps are thus formed: two lower and one upper (Fig. 6). The two lower flaps are overlapped from side to side thus reducing by one half the space between the recti muscles. The free margin of each flap is stitched with strong chromic catgut to the firm margin of the sheath of the opposite rectus muscle. The upper flap is now drawn upward and the upper margin of this lower and now double flap is stitched to the upper margin of the so-called internal ring (Fig. 7). The upper flap is next drawn downward and spread over the lower double flap and its margin stitched to the aponeurosis of the external oblique (Fig. 8).

It was found in my series of cases that in all the lower margin of this upper flap reached the point below which no stretching had taken place. The skin is closed and three small tube drains are inserted: one at each angle and one in the center of the wound. It will be seen that in the place of the relaxed wall we have now a three fold aponeurosis covering the opening and secured at every point to normal anatomical structures that have not yielded to the intra-abdominal pressure.

**CASE 1.** Mrs. N, age 49, mother of a large family had an umbilical hernia more than ten years. It has been gradually enlarging and the abdomen has been growing pendulous.

**Operation 1913.** A large elliptical incision was made from side to side. A mass of fat weighing 7 pounds was removed with umbilicus which was multilocular. The great omentum as adherent. Three flap operation performed. Recovery normal. Result excellent. Patient seen in 1917 and condition still excellent.

**CASE 2.** Mrs. H, age 53, mother of several children has had an umbilical hernia and pendulous abdomen for a number of years. **Operation 1914.** Transverse lipectomy. Fat and umbilicus removed weighing 7 1/2 pounds. Three flap operation. Recovery normal. Patient seen in 1917. Has a small inguinal hernia (bubonocoele) right side. Abdomen in excellent condition.

**CASE 3.** Mrs. S, age 43, eight children, first noticed small swelling at navel fifteen years ago during pregnancy. The patient has suffered from constipation, pain and vomiting which was diagnosed as attacks of acute obstruction.

**Operation January 1916.** Lipectomy removal of umbilicus which was very large and multilocular. It contained the lower part of ileum, cæcum and appendix, ascending colon, hepatic flexure and part of transverse colon and great omentum. The appendix was very large and markedly inflamed. The intestines and omentum showed recent inflammatory adhesions undoubtedly due to pentonitis from the acutely inflamed appendix. Recovery as normal.

**CASE 4.** Mrs. D, age 44 (I am including this case in this series though strictly speaking it belongs to another class). The patient had a large incisional hernia with a

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## REFERENCES

- 1 CUNNINGHAM T book of A at my sec p 64  
McCLANNAN ALEXIUS M ss e umb lical d e tral  
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## BOOKS RECEIVED

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Second as to the relation of case records to the success of the hospital. If case records are essential to good hospital service just why are they essential?

In answer to this question let us keep vividly in mind that the hospital exists for the patient. Let us assume that the hospital seeks to give worthy service to every man, woman and child admitted to its care—that in return it seeks the confidence and good will and even the financial aid of its community. If these conditions are true it follows that the hospital creates an equation which consists of service to the sick on its own part, balanced by proportionate and practical gratitude for that service on the part of the public. The next and inevitable step is that the truth of the equation be sharply tested. Rational and convincing evidence as to the hospital's service is wanted by the public and not general or sentimental optimism. In other words because of its very importance the hospital is under fire of criticism. In some practical fashion it must account for efficient performance in every department. It must account for the ability and in some measure for the moral worth of the doctors privileged to practice within its walls for the completeness and dependability of its laboratory reports including the X-ray for the faithful ness and intelligence of its superintendent, its internes and its nurses and for the strength of all of these to work together in single purposefulness. How shall the hospital make this accounting? Well, results are what count and the results are to be found in case records.

The first practical reason therefore as here stated for the keeping of case records is that these records are a pledge of loyalty of service on the part of the hospital to its community. For example, a patient comes to the hospital, a diagnosis of appendicitis is made, the patient is operated upon and dies unless an accurate record of the case has been kept showing the hopeless state of the patient and what was done for him, how can either the hospital or the surgeon justify a death from simple appendicitis?

#### CASE RECORDS IN ARMY HOSPITALS

The relation of the army hospitals since the beginning of the Great War to the people of this country is an excellent illustration in point. The officers of the medical department of the United States Army realized at the outset that the Surgeon General's office was accountable to the entire nation for the treatment of each soldier admitted to sick report. They realized that each soldier was in case of sickness entitled to the best service known to the science of medicine; they realized that the people of the nation were entitled to exact evidence that the sick soldier received such care. The report just issued by the Surgeon General to the Secretary of War for the year ending June 30, 1918 is a monument in the history of medicine for its effect on the civil practice of medicine. The Surgeon General in this report has presented in an intelligible fashion the exact facts as to the care and treatment of soldiers in the army hospitals. The entire report is based upon data taken from the individual case record of the soldiers. The case records for each patient were written under strict military orders and not only was the completeness of the record checked up constantly through the Surgeon General's office but the character of intelligence displayed by the medical officers through these records was also constantly held up to critical review.

Space does not permit here an analysis of the Surgeon General's report. But the question may fairly be asked as to whether or not the civilian hospital is not quite as much obligated to report the character of its work to its community as are the army hospitals to report to the Secretary of War and through the Secretary to the public. There is but one basis on which such report may be made and that is from properly kept case records.

To illustrate again let us suppose that a workman enters a hospital and learns that he needs an operation for hernia. Is it not reasonable that he should ask, "Based on your figures for other cases like mine during the past year, what chances have I to be at work again after the operation?" The question is of importance to the workman. Can the hospital answer it? Can the staff and officers

clum with easy conscience that they protect the welfare of this man by every safeguard known to medical science? If so how can they prove the claim? Or is the best of service too good for this man?

Facts facts — facts in the relevant personal history of each case facts developed in the physical findings facts brought to light by the laboratories and the X ray facts deduced through pliable wisdom from all of these and expressed as diagnoses — these are the foundation of the hospital. And unless the hospital is a matter of institutional policy is in possession of these facts filed in an orderly fashion in justification of its work it is entitled to little credit in its community or in the medical profession. To repeat the character of the case records is a test of the hospital's loyalty to service.

In taking the position here that the hospital is a public service corporation and that as such it is accountable the question of ownership or of control is not raised. It is immaterial whether the hospital is municipal state or private. The contention here is simply that every hospital is a public service institution just as a college is a public service institution. Columbia University for example is a privately endowed university controlled by a self-perpetuating board of trustees. In a broad sense however Columbia considers herself a public service institution. It makes an annual accounting to the public for the expenditure of all of its funds. It states clearly at frequent intervals its various aims and it analyzes its efforts to fulfill its aims. It states facts. Through the result of this policy and the wisdom of carrying it out Columbia stands in an exalted position throughout the world. Millions of dollars go to it unsought because it has won and merited public confidence.

#### CHECK UPON CHARACTER OF SERVICE

Emphasis in the foregoing paragraphs has been placed upon case records as a test of medical honesty or let us call it medical patriotism. A second and quite as significant a reason for these records lies in their use to prevent or minimize errors in all clinical practice to serve as a direct test of efficiency.

Medicine in its application to the needs of the human body is both an art and a science. It can never be reduced to the simplicity or to the certainty that two and two are four. The variable factor of judgment and variations in individual patients is always present. Case records if wisely kept offer an invaluable means to the hospital staff to profit constantly by its own experience in practice. This phase of record keeping was especially emphasized by the College in the announcement of its first hospital survey and in this connection the use of a summary card to make available for study and review the important data of the records was urged. But just how as a practical problem of administration are case records to be used as a test of efficiency? This question leads to a consideration of staff meetings.

#### WHY MEETINGS OF HOSPITAL STAFF?

The whole scheme of the universe is organization. If you pick up a gosling in the orchard the flock of geese will attack you. You will learn a practical lesson about organization and about co-operation. The stone men hunted the mammoth together. Our early pioneers built block houses wherein whole communities could gather and protect themselves from Indians. The building of towns whether they be towns of people or towns of squirrels or of prairie dogs is predicated on community action and on organization.

The individual doctor in the hospital can usually accomplish very little single handed. But working together all of the doctors or the staff can accomplish almost any right thing which they set out to do. Their business then is to get together to agree upon what they want and to turn wishes into action.

Doctors want good service for their patients. Now the staff meeting is the means for the doctors to get together. It is the occasion for example at which they will find out the extent of seemingly unnecessary infection among surgical cases in the hospital the character of these infections and the causes of them. Almost any problem which will present itself to the staff is related directly or indirectly to the case records. Certainly the

number of septic cases the character of the infections and the probable causes of the infections will be recorded in an adequate record system

But harmony of purpose at staff meetings and clinical facts are not alone enough. The meetings must be an assembling of live people to discuss live subjects for a definite purpose. Each meeting must get somewhere.

Are we having unnecessary infections in the surgical service? asks the head of the surgical department at the staff meeting. Certainly it is his business to know the answer to this question and in a broad sense it is the business of every member of the staff to know the answer to this question. What are the facts? Where are the infections coming from if they exist? Whose cases are they? What or who is to blame? Is it the operating room sterilization or dressing room uncleanness or water infection or is the doctor himself to blame? Open and frank discussion of such topics will lead to action and do more for a hospital than anything else.

But let us not assume that the staff meeting is to develop into a scolding bureau. Let us rather assume that every man and every woman is doing his and her level best to get good results and that the only sure way to get these results is to talk about the failures. More can usually be accomplished by recognition of merit kindly expressed than by scolding.

Again let us suppose that the medical service is up for review. Is everything going well there? Is the dietary in good hands? Is the nursing happy conscientious and adequate? Are patients given the individual attention they need? Is the hospital clean? Is the air kept pure? Is the humidity right in the wards and in the rooms? Has each case received due and prompt study aided by competent laboratory reports?

Is there any reason why such subjects as these should not be discussed by the staff with freedom, warmth and candor? Will not such discussion increase manifold the efficiency of the hospital?

Again the staff may consider the material equipment of the hospital. Is there the necessary apparatus let us say in the examining room? Let us suppose that there is not

and that the superintendent says that he has not the money to buy the apparatus. If the superintendent reports lack of funds to one doctor the chances are that the doctor will accept the report and let it go at that but if the superintendent reports to the staff the staff should not and will not be casually put off. It will insist upon its need and effectively lay the responsibility upon the trustees. It will win.

Is there co-ordination between the departments of the hospital and co-operation between individuals? Is there team work? If not the hospital will fail for success and team work live together. It takes harmony in all departments and between all departments to spell hospital success. To establish the habit of frankness in talking about these things at staff meetings will do much to create harmony.

There will be times when the trustees should be present at staff meetings to listen to whole some truths about the hospital and about themselves and about individual members of the staff. More good can be done in five minutes talk with the trustees in this way than can be done in a whole year of talk behind the backs of trustees.

How often ought staff meetings to be held? Often enough to keep up the active interest in the work of the institution often enough to keep the staff members talking about hospital progress from meeting to meeting not often enough to cause the meetings to be a burden to busy doctors. One evening a week ought not to be too much to ask of every man on the staff of a hospital to spend at staff meetings.

The objection is sometimes raised that the staff won't come. If this is true why won't the staff come? The real answer is perhaps that the meetings are perfunctory uninteresting deadily monotonous and unconstructive. If in addition to the purposes of meeting above described two or three clinical cases can be shown at each staff meeting — cases that have been well worked up the records of which are complete the resources of the hospital being exhausted to obtain a diagnosis of the disease and if all these points are brought out by the man whose case is

being shown and if there is instruction and information — then the staff meetings will be like meetings to which those same medical men gladly go hundreds of miles to attend

A staff member does not have to be a star in the medical sky to present a most interesting and instructive case. All he has to do is to have an interesting case and to present the facts marshaled in logical order. Then he will get the interest of his fellows on the staff and meetings at which this kind of work is done will be popular and productive.

The staff meeting in every hospital ought to be a red letter day in that institution and everything in the hospital ought to radiate toward these staff meetings — criticisms, complaints and commendation. The staff meetings are the clearing house of the hospital. The value of these meetings may be briefly summarized.

1. The fostering of great heartedness of determination of courage and of desire to grow in ability and worth. With right comradeship and purpose the difficult task becomes the interesting task and excuses for failure give way to action towards success. Too much value cannot be attached to the right spirit of service in a hospital staff and human nature is such that we need constant sincere interchange with our fellows to keep that spirit at its brightest glow. Repeat to me every criticism you hear said Pasteur.

I shall prefer them to praise.

The elimination to a practical degree of incompetence, negligence or laziness in the hospital first because the staff meetings serve to stimulate and to inspire each member to his highest effort and second because elements of incompetence, negligence etc. will become so plain that those who continue guilty will either voluntarily resign from the privileges of practice in the hospital or be requested so to do. All of this means protection to the patient.

3. The internes and the younger men in medicine today will in a brief period become the masters in the profession. The character of their leadership will depend much upon the inspiration gained by example during the early years of their life's work. Fearlessness in seeking truth and evidences of honor which

will develop at staff meetings will put into the hands of internes the lights which shall burn after the present masters are gone.

4. Staff meetings in time will be productive of data relative to the treatment of disease which are comparable among hospitals. When the practice of regular staff meetings becomes general among hospitals and when the facts and results of practice are regularly summarized in intelligible form we shall have a mass of information which will not only lead directly to the advancement of medicine but which will also create a wholesome rivalry among hospitals and thereby stimulate further progress.

#### PRACTICAL POINTS ABOUT CASE RECORDS

1. The basis of a good case record is keen native ability, sound training in medicine and the use of both in the care of a patient. Upon the condition of the patient depends the extent of the record. The record consists only of such facts as will be of worth to the patient in the study and treatment of the case and to the profession for its information in the treatment of similar cases in the future.

Whatever the nature of a serious illness that illness has a relation to the entire body and though briefly stated this relation should be recorded. Novel writing under the guise of case records is a waste of time, energy and money.

3. The psychology of case records is admirably designed for the prosperity of the hospital. A patient who is convinced that his case has been wisely studied and considered of sufficient importance to be recorded is usually a satisfied patient. A bond at once results from this procedure between the patient and the hospital to their mutual advantage. Sound complete physical examinations often make unnecessary what seems at first a necessary surgical operation.

4. Insistence upon case records in no way reduces the practice of medicine to a machine made process. The entire process is human and the records are human documents. They are the sincerity and reality of good work, they are the muffins and not the promise of muffins. Good records have something in them that can be made at no mill. They are



not dull facts recorded as a mere routine. They are the records both of an art and of a science the whole design of which is shot through with the purpose to prolong life to relieve suffering to make life glad and nutritious. They are a chief basis of progress in the medical profession a means to extend the science of medicine and to make surer medical practice and when the value of case records is estimated at its true worth all wavering as to the task of keeping them will end in determination.

5 Who is to be responsible for hospital records? The old saying that everybody's business is nobody's business applies to case records. If the records are worth keeping and if they are worth keeping so that their contents are available for study and review then somebody must have charge of them somebody must check them up see that they are all promptly complete conveniently accessible and protected from misuse. In a small institution not oversupplied with funds it may be wise to double up on duties in this matter. The person who keeps the records may also have other things to do perhaps in the receiving room or in the bookkeeping department. But in a hospital of considerable size and especially in a hospital of great earnestness the records are the sole responsibility of one person.

Supervision of records usually falls to a woman and if the woman is competent it may be understood at the outset that she will not be popular for a long time at least with those for whom she works. She will be a nagger and a nuisance to those who are indisposed to keep up to the hour with their records. She will have to appeal to the doctors and sometimes appeal over the head of individual doctors to the staff as a whole. But by insistence upon performance of duty the recordkeeper will ultimately win the hearty good will of the staff and render also a service mightily worth while.

6 A word about filing records and indexing. If records are useful they ought to be continually useful which means that they must be accessible. They cannot be useful if tied in bundles indiscriminately and packed away in the attic or basement.

How are records to be filed? Of course they must be filed so that any record can be quickly found in good and usable shape. Many methods of filing records have been proposed and tried but no system has been found that answers better all purposes than the envelope system or the vertical film system each record in its own envelope or folder. The patient's name and number appears on the corner of the envelope or folder so that one may readily find any record. The system of binding records in volumes meets with little approval in practice. The volumes cannot freely be taken from the library and hence the doctor who wishes to examine the record especially of a patient who returns to the hospital on a second or subsequent visit must practically have an abstract made of that record. When a patient comes into a hospital and it develops that he or she has been there before the new record should be added to the former one. It is not necessary that the record on the last visit should have the same number.

This consideration raises the question of indexing. If there is a librarian at the hospital who has charge of the records she will make her service most useful by keeping three indices each in alphabetical order of the cases as follows: First an index of the names of the patients, second an index of the final diagnoses and third an index of the organs affected. Other index entries may also be kept which concern complications.

Records indexed in this way are available for the purposes of the literature. The hospital also can readily find the patient's record where the patient is concerned by name and for the purposes of the literature the librarian can pick out required records without trouble. If a staff member for example is writing on pneumonia the index shows all of the pneumonias which have occurred in the hospital including those with pneumonia as a secondary complication. Again if the doctor is writing about an organ or the diseases of an organ or is studying some problem incident to a certain organ all the cases that have ever been in the hospital in which this particular organ was involved can be procured without delay.

# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXVIII

MARCH 1919

NUMBER 3

## OBSERVATIONS ON THE PATHOLOGY OF FOREIGN BODIES IN THE AIR AND FOOD PASSAGES

BASED ON THE ANALYSIS OF 68 CASES<sup>1</sup>

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THIS paper will not deal systematically with all phases of the subject because to do so would be to repeat much matter that has previously been written by the author and collected in textbook form (1) It would seem more profitable use of time and space to deal with new phases or new observations on the previously considered phases of the subject To report many cases *in extenso* would unduly lengthen this paper therefore with a few important exceptions comments on cases will be inserted here and there as may seem apropos and a table of cases will be appended

Autoptical opportunities have been limited to a single case therefore most of the observations herein concern the living pathology endoscopically observed

The author regards himself as very fortunate in having had a sufficiently large experience to afford many opportunities to contrast the endoscopic appearances of recently aspirated foreign bodies with cases of prolonged sojourn of other foreign bodies of the same or similar physical character Thus we are able to record and contrast the immediate and the later pathological changes produced by short and by prolonged presence of a foreign body in the air passages Unfortunately a similar opportunity has been afforded to only a slight extent in regard to foreign bodies

in the œsophagus for while recent œsophageally lodged foreign bodies are very numerous cases of prolonged sojourn are much less common in the gullet than in the air passages

*Results of bronchoscopy and œsophagoscopy* Though treatment is not within the scope of the present paper it may be germane merely to mention the fact that with the development of roentgenography for diagnosis and of bronchoscopy and œsophagoscopy for removal the future should see very few cases of prolonged sojourn of foreign bodies that have entered through natural passages Statistics in the author's clinic remain about the same namely 98.1 per cent of successes the slight diminution being due to the fact that an increasing percentage of the easier cases is eliminated by the successes elsewhere resulting in an increasing percentage of patients arriving with pathologic complications or with complicated mechanical problems Our mortality has been less than one half of 1 per cent directly attributable to the endoscopic procedure Taking together all deaths from any cause whatever within one month after endoscopy the mortality has been 1.9 per cent

*Ultimate results after removal of the foreign body in long standing cases* From a pathologic viewpoint it is unfortunate that we have had no autoptical opportunities in any of the

cases from which we have removed a foreign body of prolonged sojourn. Of the 23 cases in which the foreign body had been present for periods ranging from 2 months to 6 years all of the cases recovered perfect health except two. One of the two died about a month after removal of a nail that had been in the lung for 4 years. Postmortem was unobtainable but the symptoms pointed clearly to embolism of the middle meningeal artery. The child was known to have an endocardial lesion secondary to the septic pulmonary focus but whether the embolus was from this or from the primary infective focus in the lung obviously could not be determined (4). The other fatal case died of some thoracic or abdominal condition of sudden onset the nature of which could not be determined. He had been playing about outdoors apparently in good general health. No autopsy was obtainable (4).

The recovery of lung tissue from such extensive and prolonged suppurative processes as those present in some of the cases is very remarkable (see Roentgenograms 17 and 18). The case of Mrs. K. from whose lung we removed a glass collar button that had been in the lung for 6 years is one of the most interesting. She had emaciated from septic toxemia until she weighed only 98 pounds. Two years after removal of the collar button she had regained perfect health and today weighs 180 pounds. The physical signs over the lungs show no abnormalities (5). All of the other cases made good recoveries except the two cases noted above (21 recoveries, deaths out of 23 cases. No operative mortality).<sup>1</sup> In some of the cases it was necessary to dilate a cicatricial stricture to gain access to the foreign body for removal. It seems unlikely that from a single dilatation the lumen would remain dilated but of course it must be remembered that the lumen of the stricture was occupied by the foreign body which was itself by its bulk a large factor in the obstruction so that probably the better drainage was due as much if not more to the removal of the foreign body which occluded the strictured

lumen. Granulations are also an impediment to drainage. While doubtless they do not disappear for some time yet it is logical to suppose they would gradually recede after the removal of the cause of their presence. Their recession would constantly improve drainage. Repetition of the bronchoscopic dilatation of a bronchial stricture for the improvement of drainage is very easily carried out without anesthesia but so far our foreign body cases have not seemed to require it.

#### VARIOUS CLASSES OF FOREIGN BODIES

The list below includes the various classes of substances I have removed from the air and food passages. Needless to say it has been impossible to distinguish a different kind or degree of inflammatory reaction peculiar to each class. On the other hand I have been able to distinguish a marked characteristic and unmistakable difference between certain classes.

The following is a classified not an itemed list. In the absence of complete chemical analyses of the particular specimens the exact composition of some of the alloys is somewhat uncertain. The combinations are those in common use in the arts and trades.

#### Metals

Iron wrought  
Iron cast  
Iron malleable  
Steel low  
Steel low galvanized  
Steel low nickel plated  
Steel low copper plated  
Steel tool tempered  
Steel tool untempered  
Brass (an alloy of copper and zinc sometimes containing iron)  
Brass high  
Brass low  
Brass cast  
Brass lacquered  
Brass nickel plated  
Brass gold plated  
Brass plating  
Copper pure (practically)  
Copper alloyed with tin (bronze)  
Copper alloyed with lead (pewter)  
Copper plating on steel  
Gold solid pure (practically)  
Gold filled  
Gold plating

<sup>1</sup>See also table of results of treatment of foreign bodies in the lungs, p. 100.

Silver pure (practically)  
 Silver alloyed  
 Silver plating  
 Tin plating  
 Tin alloyed with lead  
 Tin alloyed with silver and mercury  
 Tin alloyed with copper (bronze)  
 Lead pure (practically)  
 Lead alloyed with copper  
 Lead alloyed with tin  
 Lead alloyed with antimony (?)  
 Lead alloyed with bismuth (?)  
 (These alloys are the usual ones in pewter of which we have had many instances as foreign bodies)  
 Zinc (galvanized coating on iron and steel)  
 Zinc alloyed with copper (brass)  
 Zinc probably present in other alloys  
 Nickel alloyed with copper  
 Nickel plating on iron steel and brass  
 Aluminum pure (practically)  
 Mercury as an amalgam with tin and silver  
 Antimony alloyed with lead  
 Bismuth alloyed with lead

#### Minerals (other than metals)

|               |                 |
|---------------|-----------------|
| Glass         | Anthracite coal |
| Enameled ware | Pebbles         |
| Porcelain     | Diamonds        |

#### Animal substances

|                         |                 |
|-------------------------|-----------------|
| Bones mammals           | Wool fiber      |
| Bones mammals processed | Hair (bristles) |
| Bone birds              | Horn (buttons)  |
| Bones fish              | Pearl shell     |
| Meat mammals            | Shellac         |
| Meat birds              | Seed lac        |
| Meat fish               | Entozoa         |
| Teeth human             | Blood clots     |
| Cartilage human         | Cheesy debris   |
|                         | Ivory           |

#### Vegetable substances

|              |                         |
|--------------|-------------------------|
| Nut kernels  | Celluloid jewelry poker |
| Nut shells   | chip                    |
| Seed         | Paper                   |
| Hull         | Vegetable ivory         |
| Burrs        | Wood                    |
| Grasses      | Rubber soft             |
| Fruit pit    | Rubber hard             |
| Fruit pulp   | Lacquer                 |
| Cotton fiber |                         |

#### CORROSION AND OTHER CHANGES IN THE FOREIGN BODY ITSELF

From a viewpoint of biologic chemistry this question is of only academic interest. But clinically it bears importantly on the question of reaction of the tissues to the presence of the foreign body not only by the changes in the physical qualities of the sur-

face rendering smooth surfaces rough and mechanically irritating when moved about by pulsatory respiratory and bechic forces but conceivably in the chemicals given off in the dissolving or in the corrosive processes the penetration and incubation of the bacteria etc.

*Wrought iron and steel* foreign bodies appear in our case records as having been present in the lung for periods varying from 2 hours to 11 years. In one case time was unknown probably since boyhood of a man aged 3 years. From examination of the specimens it seems certain that corrosion takes place rapidly at first and more and more slowly as the crust of corroded metal accumulates. The metal in three cases (400 410 and 569) became a mere mass of corroded material resembling coke. It lost its tensile strength and crumbled when pulled upon by forceps. The tissues had built around it in both these cases a cicatricial encasement with a narrow strictured neck from which pus escaped but through which there seemed no possibility of the corroded material being extruded either in crumbs or *en masse*. In a number of cases notably Case 408 the bulk of the foreign body was greatly increased by the heavy corrosive crust thus interfering with drainage. The polish disappeared from blued steel pins in 2 days in some instances and corrosion was always manifest when the pin had been in 4 days or longer. Galvanized coating on steel staples nails etc disappears totally in 1½ years as shown in Case Fbdy 409. The staple in this case was corroded quite deeply a thick crust covering all parts of the staple. This crust was black when the staple was removed but when dried had rather a reddish rusty appearance. This reddish appearance was not noticeable on any of the other corroded steel or iron foreign bodies. The rapid disappearance of the galvanized coating from galvanized steel foreign bodies may be favored by galvanic action.

*Cast iron* bodies we have not had in sufficient number justly to compare the degree of corrosion. Case Fbdy 550 was one of cast iron in the bronchus for 3 days. In this short time good tool steel such as is used in shawl pins and dental instruments would have

corroded sufficiently to be quite manifestly blackened. On the contrary the cast iron in the case referred to did not give off any black stain on a clean white linen cloth. Cast iron jacks in the œsophagus 2 weeks in one case (P E 34) and months in another (Fbdy 558) seemed to have undergone almost no corrosion.

Brass objects were present in the lungs of our patients for periods varying from a few hours to 10 years. Examination of these specimens shows that it corrodes much more slowly than wrought iron or steel. In Case P E 6t the thin brass wires if of steel judging by comparison with Cases 569 and 410 would have crumbled away when removed. The lacquer put upon brass to protect it from atmospheric corrosion seems to disappear very quickly from lacquered brass foreign bodies in the air passages. Nickel plating on brass seems to disappear quickly, though doubtless the removal is the result of the attack of the secretions on the brass underneath the start being obtained at spots where the plating is deficient. The mottled irregular shape and depth of the patches of corrosion on many foreign bodies notably of the atomizer tip in Case Fbdy 611 seem to support this view. The atomizer tip had been in the lung 1 year. The precisely similar foreign body in Case F L 50 was not corroded at all in 10 days. It is possible that galvanic action may favor the removal or undermining of the plating on nickel plated brass objects.

Copper corrodes very quickly and deeply the corroded surface quickly becoming rough and black. So called copper coins are in some instances made of bronze. We have not yet made a chemical determination as to which coins were bronze.

Gold seems to be very slow to tarnish. Gold plated brass seems to lose its plating very quickly and then to corrode as rapidly as unplated brass. Doubtless the attack is on the underlying metal beginning at defective places in the plating.

Nickel in the form of coins seems to be relatively slow to corrode. Nickel plating on

brass is quickly removed as mentioned under brass. Nickel plating on steel has been noted in only 3 instances and it seemed to be yielding to attack in the same way. In the œsophagus a thin yellowish adherent coating appears on a nickel coin in a central zone similar in position and area to that shown on silver coins (Figure 20 Plate II). The nature of this yellowish coating has not been determined but as the so called nickel coin is about 25 per cent copper the coating may be cupric.

Silver is very quickly corroded. The prompt formation of a heavy coating of black sulphides is more quickly developed apparently in the œsophagus than in the air passages but after silver objects have remained for a considerable time in the air passages they begin to develop a heavy coating quite rapidly. Possibly this delayed activity is due to the sulphides liberated by bacterial activity. In the œsophagus a heavy black coating appears promptly in a central zone while the lateral zones which are clasped by the tissues remain very bright (Case Fbdy 628 See Figure 20 Plate II). It remains to be determined whether the sulphide of silver or a nascent agent is bactericidal.

Lead more or less alloyed was not infrequently encountered. It seems to undergo very slight corrosion. In one instance (Case F L 243) but slight corrosion had occurred in a 10 years sojourn in the bronchus. The corrosion was slight also in Case Fbdy 440 in which the lead alloy collar button had been present for 9 years. In both these cases the pus had been exceedingly foul for years. If this foulness was due to sulphides it seems strange that the lead was so slightly acted upon. The nature of the hardening alloy has not yet been determined.

Zinc was encountered as a galvanized coating on various iron and steel substances. In these the zinc disappeared very quickly possibly as the result of galvanic action or of the undermining of the coating by attack on the underlying metallic base. Zinc as an alloy was probably present in many of the metallic foreign bodies.

Tin was encountered as a coating on wire. It seemed not to have undergone any notice

Ab sc ew th l g m th m d f th d l ry f  
th d f fcc t l h d rubb t b t t be  
th d f fcc t l h d rubb t b t t be

able change in 6 weeks. The exposed parts of the steel wire were considerably corroded. The possibility of galvanic action is worthy of consideration. The amalgam fillings which doubtless contained a large proportion of tin with silver and mercury did not seem to be corroded but none was in the air passages more than 2 weeks.

*Wood* in the two instances encountered seemed to have undergone no change other than swelling in 10 days and 3 days time respectively.

*Rubber* hard and soft seems to undergo little or no change. In Case Fbdy 6 the rubber had been in the bronchus (or trachea) for a period of 7 months and seemed to be unchanged. The surface looked slightly more porous than a new eraser but not so markedly that it could be said to have undergone any great degree of change. Vulcanite seems quite resistant but the duration in our cases was not long.<sup>1</sup>

*Pearl shell* did not lose its luster in the oesophagus in over 1 year but it was incrustated with a calcareous looking deposit in patches. It is possible that this incrustation was deposited during the lifetime of the mollusk from whose shell the foreign body had been roughly fashioned by a boy. Pearl buttons seemed to be unaffected but their sojourn was short.

*Bones* seem to change very slightly. If any disintegration goes on it is so little as to be unnoticeable. Of course there is no means of knowing the exact weight or size of the foreign body before aspiration but in Case Fbdy 608 the bone had been *in situ* 10 years and was as large as could have been aspirated through the glottis of a child of 10 years which was the age of the patient at the time of aspiration. The color of the bone (beef) was dark purplish brown. In Case Fbdy 385 the chicken bone was in the lower air passages for more than 1 year. It was cracked open evidently before aspiration and was slightly disintegrated superficially. Whether this disintegration was because of its being avian bone its age or because it was

naturally cancellous with but a thin cortex could not be determined. The differences of duration of sojourn prevented a just comparison as to disintegration between the bones of mammals birds and fish all of which are represented in our series of cases.

*Meat* (muscle connective tissue perosteum etc.) was attached to bones in only two recent cases of bronchially lodged bones. In these it was foul and soft. Doubtless it was present in other cases but had been quickly removed by the bacteria. It was of course cooked.

*Horn and vegetable work* of which buttons were made were unaffected but none was in for a long period.

*Glass* in our experience was unaffected in surface except in three instances in which incrustations were deposited after long sojourn. In Case 244 P E in addition to the incrustations the gloss usually present on glass collar buttons had apparently been dulled but of course there was no way of knowing what sort of surface was present when the collar button was aspirated 26 years previously. The glass heads of pins seemed to be unaffected as to the surface. In two instances they were slightly incrustated.

*Fiber or composition* which is a manufactured material resembling paper but impregnated with shellac or other substance to render it impervious to moisture was found in shoe buttons. One of these (Case Fbdy 630) was present in the bronchus 7 months without apparent change except loss of polish. In another case (P E 351) the button was heavily coated with incrustations after 11 months sojourn. Composition heads to mourning shawl pins were unchanged after a few days sojourn.

*Nut kernels* are supposed to disintegrate in time but we have found no evidence of it clinically. The longest duration was one month and even in this time a roasted peanut kernel seemed to be in about the same condition as one purchased for comparison. Some degree of swelling probably occurred.

*Misc beans* and other dried starchy vegetable substances seem to undergo no change other than swelling. This has an important pathologic bearing because of the pressure

<sup>1</sup> I rec t ase O Dwy t b t b mpo ed f h d  
rub lca d g id (lly?) l g h d m e h t  
y d f m th Th was d f t a chebro h t w th  
b hiet t d t t bov t l f g body Th t d f th  
rubbe w ry m h rough ed w th t Th g id cem d  
t t ed w th redd h b w cru t

exerted on the tissues and especially because of the increased interference with drainage.

*Seeds, hulls, watermelon seeds, peach stones, cherry pits* etc. were found unchanged by sojourns of from 1 to 15 days.

*Inthraxite coal, china ware, enameled ware, human teeth, wool and cotton fiber* seemed to have undergone no change but the duration was in all of the cases relatively short.

#### REACTION OF THE TISSUES—INFLUENCE OF THE CHARACTER OF THE FOREIGN BODY ITSELF ON THE REACTION OF THE TISSUE TO ITS PRESENCE

The broadest classification is as follows:

1. *Shape and size.* A foreign body that does not obstruct drainage from or irritation of the conical mass of lung tributary to the invaded bronchus in our observations has produced less reaction than a foreign body of the same physical and chemical characters but of such size and shape as to occlude the invaded bronchus in such a way as to obstruct drainage and aeration.

2. *Surface qualities.* A rough or sharp foreign body may traumatize the mucosa but the reaction of such trauma seems to be limited to the immediate neighborhood of the trauma. If the intruder is knocked about by coughing the trauma may be scattered in patches in different localities. So far as we are able to determine from bronchoscopic observations once the foreign body becomes fixed these traumatized areas heal promptly provided drainage is unobstructed. In children swelling of the subglottic tissues is apt to interfere with tracheal expulsion and then intense diffuse reaction is usual regardless of the nature of the foreign body.

3. *Composition and character.* (a) The least reaction of the bronchial tissues to the presence of foreign bodies is caused by iron and steel provided the intruder is of such shape and such size relatively to the size of the particular bronchus invaded as not to interfere with the drainage from and aeration of the subjacent lung area to which the invaded bronchus is tributary. Further experience may make an exception to the foregoing statement in case of pure gold and pure silver of which our examples are fewer and of

shorter duration than the iron bra and lead foreign bodies. Platinum of which we have encountered no instance may also be an exception. Cast iron seems rather more irritating than steel but the number of cases is too small to be certain.

b. Next to iron and steel the class of substances least irritating other than being equal is metallic substances other than iron and steel.

c. Next in order comes the dense non-absorbent mineral substances such as pebbles. Probably enameled ware and anthracite coal should be included here possibly also china ware but as only one case of each has come to our clinic the data are not sufficient to warrant the statement. Glass seems least irritating of all but as we have only one case of very long sojourn I have not put it ahead of iron and steel. We have had 3 cases of short sojourn and 1, other cases in which the foreign body was partly of glass such as glass headed shawl pins, imitation diamond etc.

d. Most organic substances set up more extensive and severe inflammatory reaction than mineral substances. The one marked exception to this is bone which seems to create singularly little reaction considering its combined septic and surface characters that favor trauma.

e. Maize dried and uncooked seems to set up a severe reaction greater than any metal but not quite equal to that of peanut kernel.

f. The most irritating of all substances we have encountered in the air passage is roasted peanut kernels. Other nut kernels (raw) are also very irritating whether less or more. It has not been determined because of the remarkably less frequency of occurrence of kernels other than peanut as foreign bodies. The botanical and chemical differences between true nuts and peanuts are well known but the bearing on the reaction of the tissue to their presence has not heretofore been studied.

Having thus broadly referred to the subject of the relative degrees of reaction observed bronchoscopically in the various classes of foreign bodies encountered we will now

consider some of the classes a little further. Additional observations have for the convenience of the reader been placed in the description of the colored plates.

*Iron and steel* Our case records are very rich in observations of iron and steel foreign bodies present in the bronchi for periods varying from a few hours to 9½ years. In one case (Fbdy 400) the intruder had probably been in the lung since childhood of a man 24 years of age. From these observations it is clear that iron and steel bodies set up quite slowly a very slight and strictly localized reaction provided they do not by their shape obstruct drainage and aeration. It is only when after prolonged sojourn the bulk of the foreign body plus swelling of the tissues plus granulations plus stricture results in obstruction that abscess, bronchiectasis and extensive tissue changes take place. Even then the changes are limited to the conical mass of lung to which the invaded bronchus is tributary. The bronchi of the other side are so invariably free from inflammatory changes that it is possible always to decide in any case of prolonged sojourn which lung to explore from a comparison of the endoscopic appearances on the two sides.

Interesting comparisons of iron and steel foreign bodies are shown in Figures 1 3 4 6 7 8 9 1 2 3 24 8 9 30 and 31 Plate I.

*Brass* is one of the most frequently encountered metals in bronchoscopy for foreign bodies. I have been able to compare the results of sojourns of various periods ranging from a few hours to 10 year. The inflammatory processes even in the cases of longest standing are strictly localized being limited to the invaded bronchus and the area of lung tributary thereto. It seems clearly demonstrated that a brass foreign body of such size and shape as not to obstruct drainage and aeration will cause only slight and strictly localized congestion followed by localized moderate inflammation. When however the inflammatory products have reached the stage in which the bulk of the foreign body plus the swelling plus the granulations plus the thick secretions interfere with drainage the saprophytes break down the pus into

irritating materials and the defective drainage and aeration otherwise result in a more rapid tissue destruction but even then the extent of destruction considering the duration and judging by the recovery of functionally good lung is most remarkably slight. Interesting comparisons are shown in Figures 14 19 and 26 Plate I. Comparison of long and short sojourns of nickel plated brass are shown in Figures 1 and 13 Plate I.

*Lead* Our experience with lead as a foreign body has been relatively large and we are able to compare the reactions set up by sojourns varying from a few days to 10 years in the bronchi (See Figures 1, 18 19 and 20 Plate I). In addition to Figure 17 there have been many cases of short sojourn mostly pewter jewelry and toys. From this experience we are able to state that the reaction from lead is relatively slight, slow to develop and always localized if the intruder is not of such shape as not to interfere seriously with drainage and aeration. Doubtless there is more or less alloy in all my lead foreign bodies.

*Gold* seems to be quite unirritating to the tissues but no case of very prolonged sojourn was observed in which solid gold of relative purity was concerned. Plated objects lost their gold coating very promptly. Filled and heavily alloyed gold objects seemed to exhibit about the same phenomena as brass. It may be that pure gold would be found to set up less reaction than steel if we could observe a case of a relatively pure gold foreign body present for a prolonged period. In Case P E 354 (Figure 27 Plate II) a gold locket in the œsophagus had set up no inflammation or even congestion. In Case Fbdy 126 Figures 1 and 28 Plate II a gold filled cuff link had ulcerated through from the œsophagus into the trachea in 3 months sojourn in an infant 6 months old.<sup>1</sup>

*Silver* in a recent case seemed to have caused practically no inflammation. In cases of longer standing the irritation seemed very slight. Whether or not the sulphide of silver or some substance in a nascent state is bactericidal remains to be determined. The corrosion in 5 days in the œsophagus is shown in Figure 6 Plate II.



*Aluminum* we did not encounter as a foreign body in the bronchi but a long experience with aluminum intubation tubes in the treatment of laryngeal stenosis leads me to believe that so long as it retains a smooth surface it is relatively unirritating but it has a strong tendency to become pitted and to become coated with incrustations. In one case that left the hospital without permission and returned after 4 months the surface of the tube was in patches like sandpaper in color and roughness owing to the incrustations. After removal the metal was found deeply pitted. The tissues which had been epithelialized cicatricial structures were denuded of their epithelium and were covered with granulations where the incrustations had been embedded.

*Plated gal an d and tinned* objects of all kinds seem to lose their plating or coating in a remarkably short time. Whether this is due to galvanic action or to the undermining caused by the attack on the basic metal a start being obtained at a defectively coated spot has not been determined. In Case Fbdy 409 the heavily galvanized steel staple was so deeply corroded into the steel in a 1<sup>1</sup>/<sub>2</sub> years sojourn that the protective galvanizing must have been off in a few months after its aspiration. Nickel plating had entirely disappeared and the underlying brass was deeply corroded in the atomizer tip present 1<sup>1</sup>/<sub>2</sub> years in Case Fbdy 611. Gold plating seemed to have lasted but a short time on various pieces of jewelry in numerous cases.

*Pebbles and glass* if smooth and free from sharp edges as in Cases Fbdy 64 P L 359 and P E 361 seem to produce but little reaction unless they cork a bronchus. In neither of the corked cases was the intruder allowed to remain long enough for extensive destruction to take place. In Case I E 244 the glass collar button was present 26 years. It is quite clear from the history that the collar button caused very little irritation for many years. Gradually however the secondary purulent processes developed ending in lung abscess and pyopneumothorax reducing the patient to a septic wreck weighing 98 pounds. What her original weight was is

unknown but after the glass collar button was removed the patient gained in weight to 182 pounds. It seems probable that the collar button which when found bronchoscopically was fixed in a position with the post crosswise allowed free escape for all secretions during many of the earlier days of its sojourn. Its surface then was smooth and unirritating. Its hardness and impenetrability and its solubility gave no chance for corrosion or for the growth of bacteria. The collar button on removal was found to be crusted with salts in places and the surface of the uncrusted portions had less luster than a new button of the same kind. It seems probable that but little irritation of the bronchi took place until incrustation of the foreign body took place and made it mechanically irritating resulting thus in introduction of the bacteria beneath the epithelial barrier. Possibly prior to this time there may have been sufficient local reaction to result in destruction of cilia and in enough swelling to interfere with escape of secretions past the intruder. Be this as it may the fact remains that this glass collar button was present in the lung of Mrs K. for a longer period (26 years) than is recorded in any other case in the history of medicine. The patient though seemingly moribund on admission is alive and well today almost 30 years after the original accident. An isolated case is insufficient even for broad conclusion but the case is in such marked contrast to many others herein referred to in which other kinds of foreign bodies were concerned that we feel warranted in the conclusion stated at the beginning of this paragraph. The slight and strictly localized reaction of glass is noticed in many instances of glass headed shawl pins and notably in the case of the teddy bear eye (Case Fbdy 583. See Figure 6 Plate II). The edema of the larynx in Case P E 341 present after 6 days was probably due to the incision of the mucosa by the thin sharp edges of a Bohemian Christmas tree ornament. Wounding of the mucosa of course introduces the bacteria beneath the epithelial barrier and moreover the subglottic tissues of an infant are exceedingly prone to develop edema on the slightest provocation.



Roentgenogram 1 Case No Fbdy 394 Safety pin  
in left bronchus of an infant aged 18 months

*Diamonds* were encountered only in minute settings in jewelry so that no distinction could be drawn between any possible reaction caused by them and by the metal in which they were set.

*Anthracite coal* was embedded in a ring of annular edema but as it had been drawn in by negative pressure due to subjacent air



Roentgenogram 3 Case No Fbdy 619 Safety pin  
in left lung of a girl aged 5 years

absorption the edema was probably from the pressure on the mucosa of the bronchial wall.

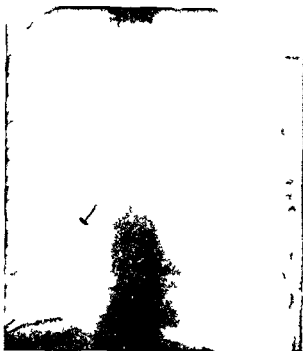
*Bone* It is a very remarkable thing that so septic a thing as a piece of cancellous bone can remain in the lungs for a period of 11 years and not produce a fatal degree of sepsis. For instance in Case 608 (Figure 14 Plate II) a piece of cancellous bone inhaled while eating soup had in 11 years set up a septic bronchitis perichondritis stricture and bron-



Roentgenogram 2 Case No Fbdy 61  
of a girl aged 3 years



Portion of safety pin in left bronchus



I oe tk 4 C N lbd 38 Uhl t ry  
 ta k m d l l l ht b l fl g l 8 y n  
 S j b t m ntl N t l t l h l  
 m ldl l b

chicetasis. Yet this boy inhaling the bone at  
 9 years of age grew and developed though



Koentz gr m C N lbd 6 At muz tp  
 glt b h y I t t g d 38 ars

constantly an invalid for 11 years. For 7  
 months before I removed the bone the boy  
 had been in bed outdoors for supposed tuber-  
 culosis. One of the most remarkable things  
 about the case is that under the antitubercu-  
 lous regime the boy increased 15 pounds in  
 weight. This is in marked contrast to the  
 rapidly fatal bronchopneumonia set up by  
 nut kernels, corn (maize) and the like in the  
 bronchi of children.

Meat in all cases was cooked. Hence it  
 probably contained chiefly or exclusively the  
 bacteria harbored by the patient and to  
 which the patient was probably more or less  
 immune. Meat even when putrid as it was  
 in most of the oropharyngeally lodged cases  
 seemed to have set up practically no reaction.  
 The most that could be noticed was only a  
 slight congestion and this only in a few cases.  
 In no case was there local inflammation nor  
 was there general reaction to indicate pro-  
 tein absorption. In one case a spicule of  
 bone in the meat had caused a wound around  
 which was a small inflammatory areola. The  
 duration of sojourn was not known other than a few  
 days in the purely meat cases but the bones



R ntg g m C N lbd 4 N l sht  
 l g of b y d y I b bl j y  
 N t sl d ltl ltl p t ly 9 y



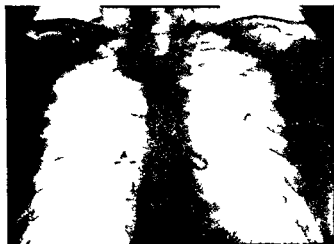
Roentgenogram Case No. Fbdy. 444. Triangular shadow shows area of dropped lung due to corking of a bronchus by a peanut shell in a girl aged 8 years.

with periosteum etc. attached were present in a few instances for a number of weeks in the oesophagus. In the air passages the maximum sojourn of bones was 11 years (Case Fbdy. 608). Whether or not softer tissues were originally attached could not be determined in any of the long duration cases, but in cases of less duration putrid soft tissues did not seem to have given rise to any special



Koenogram 8. Taken two days after removal of peanut shell in case No. Fbdy. 444 shows complete evacuation of the dropped lung.

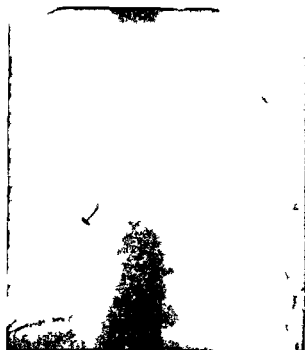
degree or extent of reaction certainly no more than bone alone excited in other cases. In no case were there symptoms similar to ptomaine poisoning following gastrointestinal ingestion. This is rather remarkable in view of the violence of such symptoms in some instances. Possibly the relatively small quantity might have been a factor.



Roentgenogram Case No. Fbdy. 400. Larval case in left bronchus of a man aged 43 years. Present year.



Roentgenogram Case No. Fbdy. 5. Dental root canal reamer in left upper lobe bronchus of a man aged 13 years. About 3 months. Pathologic halo substance.



Koe tk 4 C N III 18 U h 11  
 t k ldl 11 11 11 11 11 11 11  
 S J 1 t m 11 N 11 11 11 11  
 III 11

chicketas. Yet this boy inhaling the bone at  
 9 year of age grew and developed though



Roe tk gr C N I bdy 6 At miz up  
 n r h t b h y r P t e t d 58 y rs

constantly an invalid for 11 years. For 7  
 months before I removed the bone the boy  
 had been in bed outdoors for supposed tuber-  
 culosis. One of the most remarkable things  
 about the case is that under the antitubercu-  
 lous regime the boy increased 15 pound in  
 weight. This is in marked contrast to the  
 rapidly fatal bronchopneumonia set up by  
 nut kernels, corn (maize) and the like in the  
 bronchi of children.

Meat in all cases was cooked. Hence it  
 probably contained chiefly or exclusively the  
 bacteria harbored by the patient and to  
 which the patient was probably more or less  
 immune. Meat even when putrid as it was  
 in most of the esophageally lodged cases  
 seemed to have set up practically no reaction.  
 The most that could be noticed was only a  
 slight congestion and this only in a few cases.  
 In no case was there local inflammation nor  
 was there general reaction to indicate pro-  
 teine absorption. In one case a spicule of  
 bone in the meat had caused a wound around  
 which was a small inflammatory areola. The  
 duration of sojourn was not longer than a few  
 days in the purely meat cases but the bones



Ioe tk 6 m 6 C N III 4 N II 11  
 I g f b y g d y I III 11 9 y rs  
 N t lad s gltl r l b p te ly



Roentgenogram 14. Case No. 1 bdy 53. Glass eye of Teddy bear in right l. n. of child aged 4 year.

tuberculous. Repeated sputum examinations were negative for tubercle bacilli. A third series of roentgenographic plates made by another roentgenographer Dr. Farley, showed the presence of a foreign body and the patient started for Philadelphia.

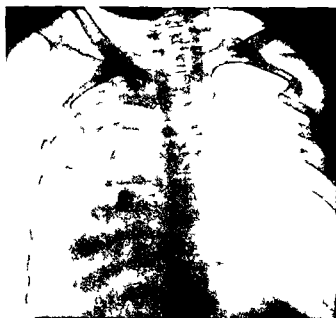
On the train he became very dyspneic and cyanotic, feverish and very feeble. He arrived in Philadelphia in very poor condition. He was brought to the hospital in an ambulance. Temperature on admission 103.3, pulse 140 and respirations 52 maximum. H. A. Hare and E. Quin Thornton both saw the patient and diagnosed bilateral pneumonia with gangrene and multiple abscess formation. The patient was apparently dying. Under stimulation administered by H. A. Hare the patient recovered consciousness, took some nourishment and went through the last religious ceremony.

His pulse became very weak. He failed to respond to stimulation. Respirations became very shallow and labored and ceased.

**Autopsy** (Submitted by E. D. Funk.) The body of that of a well developed adult white male. Rigor mortis present but easily broken up. Postmortem suffragation posteriorly and over upper anterior chest wall. Pupils are equal and normal in size. Conjunctivae slightly yellowish tinge.

Abdomen quite prominent, particularly in upper left quadrant. No external evidence of any injury.

Peritoneum is smooth and glistening. Cavities contain only a few cubic centimeters of clear yellowish fluid. Great omentum is well applied with fat and covers the intestine in lower abdomen. Appendix mesenteric approximately 10 centimeters in length and is free except at the tip which is bound down by a adhesion. It extends 3.5 centimeters



Roentgenogram 5. Case No. 1 bdy 57. Cap off brass belt lead in the right bronchus of boy aged 6 years. Probable sojourn about 2 years. Note dense pytholic shadow in right chest and compensatory emphysema in left.

beyond costal margin in midclavicular line and 6.4 centimeters beyond ensiform cartilage. Diaphragm is at upper border of fifth rib on left. Stomach greatly dilated, the pylorus sagging to level of umbilicus.

Left pleural cavity contains a normal quantity of slightly turbid fluid. Serosa over lower lobe is covered by a thin granular grayish film of exudate.



Roentgenogram 16. Taken immediately after removal of foreign body in Case No. 1 bdy 5. More air enters to be in the right part of left chest.





Roentgenogram 14. Case No. 583. Glass eye of Teddy bear in right lung of child aged 4 years.

tuberculous. Repeated sputum examinations were negative for tubercle bacilli. A third series of roentgenographic plates made by another roentgenographer Dr Farley showed the presence of a foreign body and the patient started for Philadelphia.

On the train he became very dyspnoeic and cyanotic feverish and very feeble. He arrived in Philadelphia in very poor condition. He was brought to the hospital in an ambulance. Temperature on admission 103.3 pulse 140 and respirations 52 maximum. H. A. Hare and E. Quinn Thornton both saw the patient and diagnosed bilateral pneumonia with gangrene and multiple abscess formation. The patient was apparently dying. Under stimulation advised by H. A. Hare the patient recovered consciousness took some nourishment and went through the last religious ceremony.

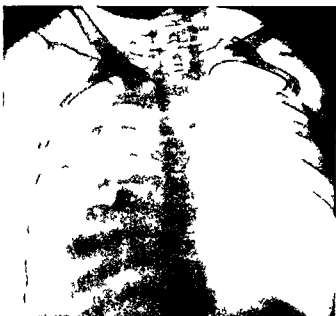
His pulse became very weak. He failed to respond to stimulation. Respiration became very shallow and labored and ceased.

**Autopsy.** (Submitted by E. D. Funk.) The body is that of a well developed adult white male. Rigor mortis present but easily broken up. Postmortem suffusion posteriorly and over upper anterior chest wall. Pupils are equal and normal in size. Conjunctivae light yellowish tinge.

Abdomen quite prominent particularly in upper left quadrant. No external evidence of any injury.

Pertitoneum is smooth and glistening. Cavity contains only a few cubic centimeter of clear yellowish fluid. Crat omentum is well supplied with fat and covers the intestine in lower abdomen.

Appendix measures approximately 1 centimeter in length and is free except at the tip which is bound down by adhesion. Liver extends 5 centimeter



Roentgenogram 15. Case No. 572. C. P. off bed to bed. The right bronchus of boy aged 9 years. Probable sojourn about 2 years. Note dense pathologic shadows in right chest and compensatory emphysema in left.

beyond costal margin in midclavicular line and 6.4 centimeters beyond ensiform cartilage. Diaphragm is at upper border of fifth rib on left. Stomach greatly dilated the pylorus sagging to level of umbilicus.

Left pleural cavity contains a normal quantity of slightly turbid fluid. Serosa over lower lobe is covered by a thin granular grayish film of exudate.



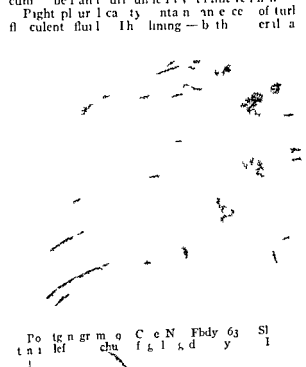
Roentgenogram 16. Taken immediately after removal of foreign body in Case No. 11345. More or less to be interpreted all part of left chest.





I tg gr m C (o l I W s l s  
v B f f t k t l s

Left lung light o gram l l u r t i c e  
u i f r m l y m t h e x e p t t b h h i h y p e r t m  
n d c o r l l y m u d t O n t i n t l n t i r e  
lung a l e m a t u l o n g e t l p e c a l l y a t b r e  
M a g i s u p p r l l e a e i g h t i l r n d e m p h y  
m t I n l e l l e t h b r n h r e i n f l a l a n d  
m a n y n t i n r u t h t h i k l k f r t h y m a t e r a l  
A l o n g t h e c o u e f t h e b r c h i n d l r o n c h i l e  
t h e l u n g t i s u l r k l f t r t h a n e l v h e  
T h i t i u e n t a n h r e t e g r a y i s h h a r l a r e s  
b u t t h i s i z e f p i n h a l t h e y a d e f i n i t l y c  
c u m b e l a n t u r r u n l e l l y a f u n t r e l l h  
F i g h t p l u r l c a t y n t a n a n e c e o f t u r l l  
f l u c u l e n t f l u i d T h l i n i n g — b t h e r l a l



Po tg n gr m q C e N F b d y 63 S l  
t n i l e f c h u f b l s d y l



Roe tg gr m q m e R tg gr m 7  
7 y f t p l b h p m l f b p p e r  
f t t h t l d b e e t h l g 7 s r s T h a  
m l t h l g u e h l t h l t h e r a g e  
n d d l f t h m e s

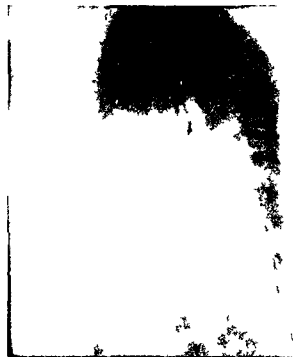
par etal — i e r d b y a t l g r a y i s h e u d a t e  
b e l o t h e l e l o f t h e t h i r d b

Right lung wgt 15 gram d i s o m e h t  
v o l u m i n u T h t r a c h e a 6 c e n t i m t e r a b o v e t h e  
l f u r c a t i m e a u r e 3 c e n t i m t e r i n d m e t e  
J t b o y t h e b i f u r c a t i o t h e l e f t b o n c h u s m e a  
s u r e 2 c e n t m e t e r s T h e i g h t b r o c h u s 3 c e n t i  
m e t e r i n h i s m e t e r T h e u c o o f t h e t a c h e a i s  
c o l l n a n d a l m t b l a c k c l r l s u r e u p o n t h e  
l u n g c u e f o u l s m e l l i n g n t e i d t o e u d e f r m  
t h e t r a c h e a S t i o n o f t h e l u n g e v a l m a y  
l e c e f v a r i o u s s e a l h a p s m o t n u m e r  
o u i n t h e m i d d l e n l l e r l b a n t s t u a t d i n  
g r o u p l i n g t h e c u r e o f b n h u d b n c h l e s  
H e r e m u n y h e c d e d a n l n t a n s o f t n e c r o t i c  
e r t e T h b r o c h i m c o r a s o l l e n n d t h e  
b r o c l t l l e l t h m u c o p u r u l e n t e x u d t e I n  
t h e l v e r l o b h e e t h e l u g b l a c k v e r y s f t a n d  
f r i a b l e a l i n t u c t l y g a n g r o u a e a m a y b e r e n  
B r n c h i a l l y n p h n o d s a r a b u n l a n t e n l a r g e d a n d

l e m t u  
l h e p e r i d i u m  
c a t y c o n t a i n a s n  
e r u m  
l h e l e a r t e g h  
y c n t m e t e s  
e a u r e s 2 6 c n t i  
r d u m d a r k r e  
e o f t h e h e a t  
h d a r k r e l c l o t  
a l e p p a e n t l  
t o f t h e m i t r  
a n l i g h t e n n g T h e  
o f c l e r d e p y e l l o  
a n d m a u r e 15  
o f t h e l e f t e n t r c l e  
c k n e T h e m v  
o n t e l T h e r i g h t  
t h e c a t i e s a r e f i l l e d  
s a l o i f e s o f t h e  
n t O t h e a t e  
t y e l l o i h r



Roentgenogram of Case No 1 bdy 608 Bone in right bronchus of boy aged 5 year Probable sojourn 11 years Note pathology in right lower lobe



Roentgenogram of Case No 1 bdy 578 Pearl shell ring in esophagus of a boy aged 3 years Probable sojourn 1 year

areas Two aberrant chorda tendineae span the cavity of the left ventricle The foramen ovale is close

The spleen weighs 175 grams and measures 14 by 6 by 3 centimeters The organ is lightly enlarged the capsule is smooth and free from adhesion On section the pulp is firm and presents no gross lesion Adrenal no microscopic change

The right kidney weighs 230 grams and measures 13.5 by 6 by 4.5 centimeters The kidney bed is well supplied with fat The capsule is smooth thin and easily stripped An incision shows no change in the cortex except swelling and congestion The ureter is single and patulous

The left kidney weighs 60 grams and measures 1.5 by 6 by 4.5 centimeters It presents same general appearance as its fellow Ureter single and patulous

Bladder no gross change

External genitalia apparently normal

The liver weighs 170 gram and measures 29 by 19 centimeters The capsule is smooth and tense the edges rounded On section the liver is firm and dark red with yellowish mottling The veins are full of blood The gall bladder extends 3 centimeters below the margin of the liver and contains a small amount of yellow bile The biliary passages are patulous

The stomach is greatly dilated and partly filled with thin granular grayish material and air The mucosa is flattened and smooth

The pancreas weighs 100 grams and measures 18 by 4 centimeters No lesion is discernible

The rectum shows several raised grayish patches most numerous at the arch

The intestine show nothing noteworthy

*Gross diagnosis* Multiple abscesses of lungs septic pneumonia with beginning gangrene oedema and congestion of lungs acute fibrinous pleuritis dilatation of right heart and stomach cloudy swelling of kidney and liver congestion of myocardium acute suppurative bronchitis and peribronchitis

*Bacteriologic diagnosis* Inoculations from the trachea yielded pneumococci staphylococci bacillus of Friedlander streptococci and a gram negative motile organism which could not definitely be identified

*Microscopic diagnosis* Left lung acute suppurative bronchitis and peribronchitis acute suppurative pneumonia septic pneumonia Right lung acute suppurative bronchitis septic pneumonia oedema Heart granular degeneration Spleen congestion Liver congestion granular degeneration Peribronchial lymph nodes acute non suppurative lymphadenitis Kidney slight congestion cloudy swelling Pancreas normal Adrenals normal

*Coffee berry* We have had two instances of coffee berry one roasted the other not Both were in children The unroasted berry had set up a violent diffuse tracheobronchitis with a copious accumulation of pus The roasted berry had caused a diffuse reaction but of less severity

*Peanut kernels* Of all substances that we have encountered in our bronchoscopic ex-

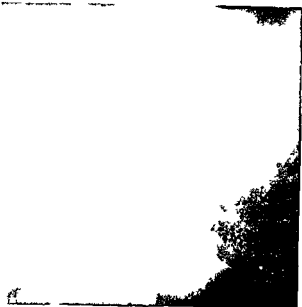


Fig. 1. Peanut kernel. (N. H. L. 500. I. I. 1st)



Fig. 2. Walnut kernel. (N. H. L. 500. I. I. 1st)

perience peanut kernel set up the most prompt and violent reaction. All of our patients were in children. The younger the child the more severe the reaction. In a number of cases a peanut kernel in a few hours produced a diffuse general tracheo-bronchitis. Three cases in which we were not permitted to do a bronchoscopy died within a week. In (Case 64) a child aged four

showed violent tracheo-bronchitis with profuse exudate from the week of insertion of peanut kernel in the bronchi. Had the child been younger it is doubtful from a clinician's point of view if the child would have lived this long. Many similar cases are now in our case record and while the degree of inflammatory reaction varies with the age of the child and with other and unknown factors the evidence is sufficient to warrant the statement made at the beginning of paragraph. In some of the cases the pus was so copious as to be coughed out on insertion of the broncho scope onto the bronchoscopy gown dripping thence to the floor.

Observations on the use of peanut kernel have been so numerous in the bronchi because no other foreign body has caused such a violent reaction in the esophagus has caused such a violent reaction in the

The only other nut kernel encountered as a foreign body was a walnut kernel. This patient (Case 164) an infant of 17 months developed a most violent tracheo-bronchitis in three days of the kernel. The similarity to the more remarkable case the so-called peanut is not truly a nut botanically speaking whatever it may be chemically. Moreover the walnut kernel was raw whereas the peanut kernel were all so far as known cooked.

Hypothetical questions come to mind in comparison of the foreign body of the oral surface of the tongue with the attempt the solution of the problem by the use of the theoretic and surgical methods of the laboratory and are based upon the present

any hypothesis reaction of the esophagus on the part of the body by the resort to which kept the dark field of the esophagus in the present day purpose

servations of living pathology Recognizing the dangers of theoretic pathology we are however justified in considering certain established facts in regard to the reaction of tissues to the presence of various substances These will be alluded to briefly in connection with the various classes of substances

When one notes the readiness with which certain substances are encysted in bacteria free tissues there is an unavoidable suspicion that bacteria are largely concerned in the wide variation in the degree to which different foreign bodies in the lower air passages cause reaction This naturally brings up the questions

What is the relative suitability of foreign bodies of various kinds to serve as carriers of bacteria? To what extent is such suitability a factor as compared to the after service of the characters of the foreign body as a matrix an occluder of drainage and aeration a helper of bacterial growth as a medium or other wise?

Other general questions are To what extent do certain foreign bodies facilitate penetration of bacteria through the epithelial barrier by means other than purely mechanical puncture and the atria resulting from the inflammatory outward migration of leucocytes? Can certain kinds of foreign bodies impair ciliary activity by means other than the excitation of inflammation?

Undoubtedly one of the factors in the pathologic processes is the impairment of ciliary activity On how soon after the invasion the impairment takes place in other words, whether the primary inflammatory processes stop or seriously lessen this activity or whether it is in the later destructive inflammatory processes that the cilia are destroyed bronchoscopy has as yet not thrown any light Plans for working out this problem have been made

The relative activity of the cilia in adults and children seems never to have been determined

It may here be mentioned that previously reported bronchoscopic observations by the author<sup>1</sup> have established the fact that the

flow of the stream of secretions under normal conditions is greatest up the posterior wall of the trachea and out the posterior commissure of the larynx between the right and left arytenoid eminences (Fig 10 Plate I)<sup>2</sup>

Previously referred to bronchoscopic observations and cultural tests by the author have also established the fact that the mucosal surfaces of the bronchi are not absolutely and at all times sterile but they are occasionally so and the deeper (more peripheral) the location the fewer the organisms Doubtless this is because under normal conditions the organisms are swept out by the flow of sterile secretions poured out by the mucosal glands and propelled by ciliary bechic and forced expiratory action voluntary and involuntary

Hypothetical questions suggested by Dr W M L Coplin upon which we hope later to have laboratory data are

1 Do metallic foreign bodies give off in the process of corrosion bactericidal products?

2 Are the vastly greater irritating properties of such substances as peanut kernels due to

a Irritating chemical substances present in the peanut either naturally as the abrin in jequirity or ricin in the castor bean or developed in the roasting process? Ricin is non toxic when taken into the gastrointestinal tract (Jacob Rosenbloom suggested to me the testing of the possibly irritating properties of arachidic acid as an irritant This saturated fatty acid is present in about 5 per cent strength in peanut oil)

b The contact of an alien protein with tissue not naturally accustomed to such substances the alien protein not having previously gone through the mill of enteric and hepatic preparatory processes?

c The protective matrix afforded by a porous organic vegetable protein for the growth of bacteria in a warm moist incubating chamber such as the living bronchi the bacterial growth giving off irritating toxins or acquiring virulence to enable the organisms to attack the living tissues?

1 At th agest f D W M L C pl th ha nc  
m d f rth b rv t ns by wh h t w d ed that th  
t d cy fth d t h l blood tre k selected th post r w ll  
wh th p t was t d g th f ect t th am  
ecumbent pat t l th w d posture had l th  
p ed lect fth d tra h l blood tre k f th po t w ll

F Motal E doco py d Larj cal S gery T thook 9 4 Also  
Arch f diag Ap 1903

3 Is the reaction to the presence of the peanut simply an unusually violent effort of nature to split up and get rid of a very complex alien protein by an unnatural route

4 Is the relative mildness of the reaction from so septic a substance as a cancellous bone as compared to a peanut kernel explainable upon the basis of the well known toxic properties of alien proteins?

*Cough* is an aid to ciliary activity is important *Bechic inefficiency* in infants and young children as compared to adults in whom voluntary expectorative aid is a large factor has been demonstrated by the author (3) Possibly this is one of the factors leading to the greater vulnerability of children to the reaction of foreign bodies

#### LOCATION OF LODGMENT OF FOREIGN BODIES IN THE BRONCHI

A distinction must be made between the location of primary lodgment and of ultimate lodgment. The latter term must be used with reservations since if the patient lives nearly all bronchially lodged foreign bodies migrate continually downward and outward toward the periphery of the lung at first as far as the size and shape of the intruder relatively to the size and shape of the bronchi will permit. Later pathological processes fix the foreign body. Still later the intruder may ulcerate loose and migrate farther toward the periphery but this is relatively very rare. Usually the intruder remains fixed in inflammatory tissue while the subjacent purulent processes migrate toward the pleural cavity into which they often enter causing a pyopneumothorax. In only one of our cases that came in with this condition had the foreign body followed the pus into the pleura. In none of them had the intruder worked its way through an area of adhesive pleuritis to the skin surface but such cases have been recorded in the prebronchoscopic days.

*Foreign bodies often lodge in the larynx.* These instances were chiefly in the case of large long or sharply pointed substances lodgment taking place because of a point sticking into the walls or into the ventricles. In a few instances lodgment was due merely to size. In more than half the cases that came

in with foreign bodies in the bronchi there was good reason to believe that the intruder had first lodged higher and had been dislodged by natural reflexes or by efforts at removal especially ill advised efforts in the upright posture.

Nothing new statistically or otherwise has developed to lead me to alter the statement previously made (1) as to the greater frequency of right sided lodgment and reasons therefor the rarity of middle lobe lodgment the influence of size shape specific gravity and other characters on lodgment nor as to the rarity of spontaneous expulsion. Further observation corroborates the fact then noted that lodgment is almost always at or below the orifice of a branch bronchus because probably of the fact that the bronchi do not diminish in diameter tapering between branches. The branching is of monopodic type and the interramal parts of the bronchi are relatively cylindrical. The most frequent site of lodgment is shown in earlier observations is it or immediately below the giving off of the right upper lobe bronchus usually far enough below to permit air to enter the upper lobe bronchus over the top of the foreign body. The next most frequent site is the corresponding anatomical location on the left side. Next in order of frequency are the stem bronchi first the right then the left. The dorsal branches of either side are much more frequently invaded than the ventral branches the most frequent of all being the large posterior branch of the left inferior lobe bronchus that is given off immediately below the left upper lobe bronchus. The data bearing on this subject have already been published (1).

*Participation of the other lung in the bronchitis of foreign body origin* does not usually occur in recent case except when the intruder is of the extremely irritating class such as peanut kernels and muze. In the diffuse bronchitis of both lungs the rule so much so that the bronchoscopist is deprived of one of his best guides for finding the location of the foreign body namely the evidences of pathology at or near the orifice of the particular bronchus invaded. The evidences of inflammation are not localized in such cases

as they are in metallic bodies for instance. In case of metallic and other mineral bodies present for a long time there is usually a mild degree of chronic bronchitis in the other lung due doubtless to the secretions getting over from the invaded lung during sleep and at other times when the cough reflex and the ciliary activities are lessened. The same is true of bones and of all inorganic substances. But in all of the cases of substances other than the irritating class (nut kernels maize etc.) the evidences of pathology are relatively so slight that there is no trouble in going directly to the invaded bronchus by following the signs of pathology provided the intruder has been *in situ* sufficiently long to produce marked pathologic changes.

*Tissues involved in the reaction to the presence of a foreign body.* It is logical to suppose that primarily the lodgment of a foreign body in a bronchus produces a reaction limited to the mucosa. Many foreign bodies owing to impact on aspiration of the foreign body or on its being knocked about or by the friction caused by respiratory pulsatory and hecic movements perforate the mucosa introducing the bacteria and attendant inflammatory processes into the perichondrium the cartilage the interannular tissues the vessels and all the tissues composing the parenchyma of the lung.

#### CAUSES OF REACTION OF BRONCHIAL TISSUES TO THE PRESENCE OF FOREIGN BODIES

It is probably justifiable to assume that the causes of the reactions of the mucosal and adjacent tissues to the presence of a foreign body may be classified as mechanical chemical biomechanical and biochemical.

*Mechanical causes of reaction of the tissues to the presence of foreign bodies.* These are easily understood and admit of little dispute. Direct trauma of a foreign body by the impact of its striking when it is a pirated with projectile like force assisted or not by gravity is easily understood. So also is the puncture of the epithelium either on the impact or later as a result of the chafing due to the to and fro excursion of the contactual bronchial wall in the respiratory hecic and pulsatory movements which are continuous

As previously pointed out by the author long objects pointed at one end only such as pins ticks and the like have a ratchet like movement by which they work downward to the lowest possible location due to the prevention of upward return by the sticking of the point into the lateral wall. The axis of the foreign body not coinciding with the bronchial axis because of the relatively large diameter of the latter the point which is almost invariably upward sags over into contact with the bronchial wall into which it penetrates during the subsequent longitudinal shortening of the bronchus during expiration cough or transmitted cardiac or vascular impulse.

Under mechanical processes may also be included the occlusion or 'corking' of a bronchus by which drainage and aeration of the subjacent tributary lung is interfered with. This obstruction may be contributed to by swelling of the tissues swelling or corrosive increase in the bulk of the foreign body.

*Biomechanical processes* may include (a) the irritating roughness induced in a foreign body by corrosion and by the incrustation of a foreign body secondary to tissue reaction (b) the swelling of the foreign body due to the absorption of the ever present secretions normal or pathologic resulting in great lateral pressure (c) the increase in bulk of the intruder by corrosive processes (d) the swelling of the bronchial wall obliterating the airways that on first invasion existed at certain points between the foreign body and the bronchial wall due to irregularities in the shape of the foreign body.

*Chemical processes* include those in which the intruder contains material which is directly irritating to the tissues.

*Biochemical processes.* In this classification might be included the reactions on the tissues produced by irritative agents developed by bacterial or tissue cell activities.

*Age in relation to reaction of tissues to foreign bodies.* Our observations show beyond doubt that the larynx trachea and bronchi of infants react much more severely and generally to foreign bodies than those of adults. This is especially true of the subglottic region in children aged less than 19 months. Their

subglottic tissues will swell until in the most severe cases they meet in the middle line and will asphyxiate the little patients unless a tracheotomy be done to supply air until the subglottic oedema subsides. I cannot kernels seem peculiarly liable to set up this subglottic swelling. Subglottic oedema in infants is however not peculiar to foreign body cases. We have often seen it in acute laryngo tracheitis commonly called the grippe or broncho pneumonia. In quite a proportion of the cases of laryngeal and tracheal diphtheria in infants in our observation it is often this subglottic oedema rather than the bulk of the membrane that necessitates tracheotomy or intubation. Logan Turner has shown the peculiar histology of the subglottic region in children and doubtless structure is the chief factor in the tendency to subglottic oedema in infants. Our youngest patient was 11 days old.

**Contact reaction.** The mere contact (with out impact) of a foreign body in the trachea or bronchi seems to cause very little reaction. In Case Fbdy 557 the needle in contact with the mucosa after it had been in the lower air passages for 2 hours had caused only a slight congestion. This seemed to be the case in most instances of metallic bodies of short sojourn though none was quite so short as that of the needle. In a number of peanut cases of very short sojourn a diffuse general reaction was set up. The mechanical irritation of contact of a peanut would theoretically seem much less than that of a metallic body. The reaction from contact of the bronchoscope in a careful gentle bronchoscopy seems very slight and successive introduction of the instrument shows that the slight congestion caused very quickly disappears provided no abrasion of the epithelium has occurred. The reaction from improper rough violent use of the bronchoscope as shown in Figure 3, Plate I is followed by more or less severe traumatic bronchitis.

The slight reaction from mere contact observed endoscopically corresponds to clinical findings. When each one of us recalls the violent choking and strangling excited in our selves by a mere crumb of bread that has

gone the wrong way we really refer only to laryngeal sensations. Strange as it may seem the deeper passages are quite tolerant for foreign bodies. In most instances after the coughing and choking excited by the presence of the foreign body while passing through the larynx practically all cough ceases. It is thus deceptive and little known period of quiescence that deludes patient and practitioner into believing the foreign body could not have entered the lung. In Case Fbdy 409 (Figure 8 Plate II) the family physician when called immediately after the accident said "Impossible. You would have been dead in 5 minutes and would have been coughing your head off the whole time."

#### CASES OF PROLONGED SOJOURN OF FOREIGN BODIES IN THE AIR PASSAGES

Of the 23 cases in which the foreign body had been in the lung for periods ranging from 3 months to 18 years the clinical signs of pulmonary sepsis supervened and the patients developed the clinical picture of pulmonary tuberculosis yet in not one of the 23 were tubercle bacilli found though repeated examinations were made. Moreover the relatively prompt and complete recovery of the patient in 16 out of the 23 cases clinically substantiated the bacteriological findings. It seems therefore that the statement that appears in many textbooks that cases of foreign body in the lung are prone to die of pulmonary tuberculosis is a relic of the days when the diagnosis of tuberculosis was made upon clinical and not upon the bacteriological or even pathological data.

The predominant characteristics of the pathologic processes of the 3 cases of prolonged sojourn of a foreign body in the bronchi were

1. Foul and dark colored or greenish pus indicating the presence of saprophytes and chromogenic bacteria.

2. Presence of an abundant bacterial flora without distinctly predominant varieties of organisms.

3. Absence of bacillus tuberculosis.

4. Presence of a stricture of the bronchus the foreign body occupying the lumen of the stricture in 16 out of the 3 case.

5 The presence of a cavity varying from a slight dilatation of a bronchus to an abscess cavity though in most instances the cavity was filled with granulation tissue and usually its walls were collapsed. In some instances the cavity gaped on inspiration after removal of the foreign body and bronchoscopic aspiration of the pus in one instance the cavity was inflated with the caisson bronchoscope (Figure 9 Plate II)

6 The location of the foreign body at the upper part of the pathologic mass. In all save two of the 23 cases of prolonged sojourn of a foreign body in a bronchus the foreign body was located at the upper part of the diseased tissue which has resulted from its presence. In the cases in which cavities of abscessal or bronchiectatic character had resulted the foreign body was in all cases but two located in a stricture at the top (or proximal end) of the cavity.

*Pus and secretions in foreign body cases*  
Systematic laboratory work has unfortunately not been carried out in all cases. The cases that were investigated however revealed the same organisms and the same tendency to mixed infections that are found in other inflammatory states of the bronchial mucosa. Pure cultures of one organism were not found in any instance. The specimens so far studied showed in the cases of prolonged sojourn the same histologic and bacteriologic elements as are found in bronchiectasis and lung abscess. It is unfortunate that this abundant opportunity for investigation of these relatively rare conditions was not taken advantage of for systematic and thorough laboratory work. Arrangements are now made to do better in the future. Clinically the secretions of relatively recent cases were mucopurulent in character often tinged with blood. In the peanut cases (all children) the mucopus in most instances was pinkish in color. In all the cases of prolonged sojourn the pus was characterized by being of very foul stale odor. Usually the color was rather dark and somewhat greenish rather than than thick not creamy. In some cases it was rather stringy. As soon as sponging was commenced in the procedure of bronchoscopy the oozing of blood from the

granulations made the pus bloody to the extent that all other characteristics were lost except the odor which persisted most obstinately. In many of the cases of peanut kernels maize etc the pus (often of laudable character) was coughed out as soon as the bronchoscope was inserted in such copious quantities as to drip from the bronchoscopist's gown to the floor.

#### DROWNED LUNG AND LUNG ABSCESS

It is my custom always to take a roentgenograph of the chest after the removal of the foreign body for comparison with the one taken before the bronchoscopy. This has led to the discovery that much of the opacity of the subjacent lung tissue in recent cases disappears after bronchoscopy evidently due to the usual bronchoscopic sponge pumping out of purulent secretions. In cases of prolonged sojourn of the foreign body in the lung the same thing is noticeable but to a less degree and there still remains in the latter class of cases much opacity as compared to the other side. Possibly part of the contrast of the two sides is due to compensatory emphysema of the uninvaded side but allowing for this there is unmistakable opacity. In the course of years (ranging from 1 to 10 in our records) the shadows almost entirely disappear though traces may be visible long after all symptoms have disappeared and all physical signs have become normal.

When the drainage from a bronchus large or small becomes obstructed the secretions accumulate below and we have the natural passages filled with secretions which are or soon become purulent. This condition we have fallen into the custom of referring to as drowned lung. It may give the same note as an atelectatic area and the two conditions may co exist. Clinically it differs from true abscess in that it may develop rapidly within a day or two in some instances and in that if relieved at once by removal of the foreign body recovery from whatever local reaction may be present is almost always prompt and complete. If however the area of drowned lung is not relieved by removal of the foreign body from the bronchus the bacteria become



active in the pent up secretions the saprophytes decompose the secretions the toxins and other products of bacterial activity together with the inflammation result in destruction of the cilia the epithelium then the subepithelial tissues and the perichondrium the cartilage itself dies and we have a cavity. Across one such cavity there stretched a band of tissue which had an appearance of branching (Figure 9 Plate I). As to the nature of this band it is impossible to say. It may have been cicatricial tissue left during the lifting from one previous stage in the course of the inflammatory changes in the reaction of the tissues to the presence of the foreign body. It seems more probable however that it was some of the natural tissues more resistant than the others to the pathologic processes. Its form suggested a small branch bronchus though the author's experience with purulent processes about the larynx is that perichondrium and cartilage are very prompt to become involved and break down under purulent processes. The interior of the abscess wall in the case with the band was lined with large mushy flabby granulations which entirely filled the cavity. Possibly this apparent filling may have been due in part to collapse of the walls. Be this as it may the interior could be explored only by crisson bronchoscopy a method devised by the author for endoscopically inflating lung abscess cavities during examination. This case and the method have been previously reported. In the absence of autopsies it has been impossible to determine by bronchoscopy alone in every case whether an observed hollowiness constituted an abscess cavity or a bronchiectasis. The region below the stricture that held the foreign body was in every case of prolonged sojourn lined with bleeding inflammatory tissue endoscopically resembling granulation tissue. In some of the cases in which there had been relatively free drainage around the foreign body in the interstices between it and the bronchial wall the latter more or less altered by chronic inflammation was visible in certain portions of the visible field. As near as the author has been able to determine the condition has been one of bronchiectasis in

10 cases and of abscess properly so called in 6 out of 3 cases of prolonged sojourn of foreign bodies in the lung. In the other 7 cases no conclusion as to which to call the condition could be arrived at bronchoscopically. Foreign body abscesses have been known to have a tendency to rupture into the pleural cavity or the mediastinum.

*Drowning of the patient in his own secretions*  
In the foregoing paragraphs reference is had only to the drowning of sections of lung. The author (3) has previously called attention to the fact that glottic impairment can cause the bronchi and trachea to fill up until the patient will actually drown in his own secretions. It is a true drowning in the sense that fluid by its presence mechanically prevents atmospheric air from reaching the capillaries of the air cells. This condition has arisen in our foreign body cases chiefly in children whose subglottic tissues for anatomical reasons are peculiarly susceptible to edema. This edema occurred in 3 classes of case.

1 Those in which a loose foreign body had been knocked about in the trachea by cough.

Those in which the foreign body was of such peculiar character or accompaniment as to have excited a very violent diffuse reaction in the tracheobronchial tree.

3 A foreign body so jammed in the glottis as to prevent glottic closure in the bechic cycle.

4 One adult patient who had a recurrent paralysis before the foreign body accident.

The mechanism of bechic expulsion of secretions (or anything else) is briefly.

1 The taking of a deep breath filling the lungs with air.

Tight closure of the glottis.

3 Contraction of the expiratory muscles to raise the air pressure.

4 Sudden opening of the glottis releasing the compressed air and gases in the chest.

5 Outward rush of the blast of compressed air and gases through the bronchi trachea larynx fauces and mouth the blast carrying with it secretions and foreign bodies with a varying degree of efficiency.

The efficiency depends as one of its chief phases upon free glottic movement as well

as upon glottic patulency. If the glottis can not close tightly preliminary compression of the intrathoracic air is impossible so that the outward rush lacks suddenness hence its efficiency as a secretion remover is lessened. If the glottic chink is narrowed so that its maximum exposure does not permit thick secretions to pass the efficiency is impaired obstructively.

#### BRONCHIAL STENOSIS SECONDARY TO FOREIGN BODY

*Recent cases.* Bronchial stenosis in cases of globular or cylindric foreign bodies of more or less regular outline so far as we could determine resulted promptly from the wedging of the respective foreign bodies by impact in the smallest bronchus they could enter. Thus occluded absorption of air took place in the tributary lung below resulting in a negative pressure which forced the intruder farther and farther down. Then the inflammatory reaction in the neighborhood of the foreign body resulted in an annular oedema on the proximal side of the foreign body. Whether or not a similar condition existed below could not always be determined because in acute cases there was not often any justification for reinsertion of the bronchoscope after the removal of the foreign body. But the swelling on the proximal side constituting as it does one of the difficulties to be overcome in the bronchoscopic seizure of the foreign body was only too obvious. It was present in every recent case in which a cork like occlusion of a bronchus had existed for a day or more. When a foreign body of somewhat irregular shape enters a bronchus for a time the air can pass through the interstices left by the irregularities as in Figures 6 and 12, Plate II. These interstices may be more or less occluded if small by this mucopus. If large air and secretions may pass for a varying length of time probably depending on the rapidity and intensity of the mucosal swelling which the particular foreign body may excite the thickness of the secretions the size of the bronchus or rather the amount of cubical capacity of the subjacent lung on which depends the force of the respiratory and bechic blasts. A slender foreign body such as a pin

located in a relatively large bronchus had not resulted in bronchial obstruction in any of our cases short of 5 years. In Case Fbdy 569 the exact time elapsed before obstruction supervened could not be determined but occlusion was practically complete when the first bronchoscopy was done 5 years after the aspiration of the pin.

*Cases of prolonged sojourn.* In all the cases of prolonged sojourn of a foreign body in a bronchus there was more or less obstruction. This stenosis was composed of the foreign body plus the inflammatory sequelæ cicatricial stricture granulation tissue and purulent secretions these various factors being present in varying degrees in the various cases.

*Encysting of foreign bodies in the lung.* Anthracosis concerns only relatively minute foreign bodies which by reason of the small size reach the bronchioles and air cells. The author's observations concern only foreign bodies of relatively large size which necessarily occupy bronchi of a size not less than probably 3 millimeters in diameter. Such bodies probably rarely become encysted. If the bronchus closes proximally the locked up bacteria and their pabulum form an abscess in most instances. In only two cases in the author's experience was a foreign body of size truly encysted and even in these the encysting may ultimately break down and result in abscess formation. There are five factors that probably contribute to prevent encysting of a foreign body in the lung.

- 1 Infection
- 2 Patulency
- 3 Epithelialized surfaces
- 4 Movement
- 5 Penning up of subjacent secretions normal or abnormal the passage of which maintains an open channel when forced upward either by bechic or accumulative pressure.

#### COLOR PLATES

The illustrations are reproduced by photo engraving from the original oil color drawings painted by the author from his sketches made immediately after the removal of the foreign bodies. They all represent the living tissues (except Figure 9, Plate II) as seen through the







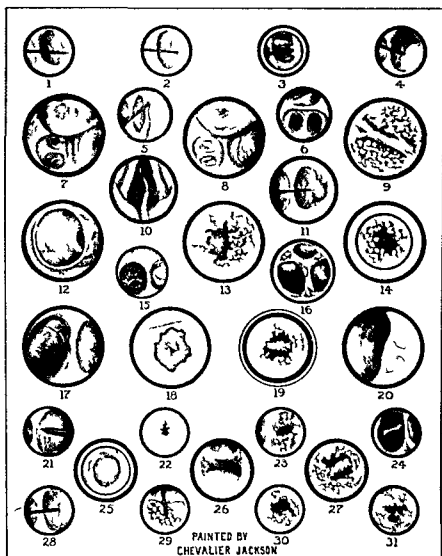


PLATE I



similar foreign bodies (steel pins with glass handles) present for various periods from 2 days to 5 years.

Fig 10 Same case as in Figure 5. Tiny stream of blood is seen to be carried by the cilia up the posterior wall of the trachea and out the pitcher mouth between the arytenoids. This original observation of the author has been observed in previous and subsequent foreign body cases. Occasionally it is seen in tuberculous case. At intervals the cough removed the streak of blood but it was soon replaced in cases in which the bleeding continued in sufficient and not too great amount. It was not noticeable in copious hemorrhages.

Fig 11 Case Fbdy 552 Dental root anal reamer (tool steel with brass handle) in left upper lobe bronchus for 3 months. The point has entered the wall of the main bronchus the point of entrance being surrounded by an inflammatory areola. A small patch of exudate adherent. The local and mild character of the inflammation is important. Compare Figure 6 which shows the endoscopic appearances in a case of only 2 days' sojourn of a similar instrument.

Fig 12 Case 30 P E Man aged 76 years. Nickel plated brass atomizer tip in right stem bronchus 60 days. Inflammatory reaction localized probably because the foreign body is not of very irritating character and on inspection to the hole in the distal end it does not obstruct drainage. Nickel plating tarnished but not corroded. Peroral bronchoscopic removal. Cure.

Fig 13 Case Fbdy 611 Man aged 38 years. Nickel plated brass atomizer tip in right stem bronchus 1 1/2 years. The size, shape and position of this foreign body is precisely the same as in the preceding case (see Figure 2 above). The granulation tissue that obstructs the view into the interior of the atomizer tip has developed as the result of a 1 1/2 years' sojourn. The granulations surmount a firm fibrous stricture which required bronchoscopic dilatation for the removal of the foreign body. Pus very foul. Perichondritis present. Nickel plating entirely gone. Brass much corroded. Peroral bronchoscopic removal. Cure.

NOTE—The localized character of the inflammatory processes in the cases illustrated in Figures 2 and 3 noteworthy and is probably due to the relatively unirritating character of the foreign body and to its form, which because of the opening at both ends did not greatly obstruct drainage.

Fig 14 Case Fbdy 572 Boy aged 9 years. Brass cap from bedstead in right main bronchus 1 year and 9 months. The general shape and position of the foreign body are similar to Figure 2 but there is no hole in the distal end of the cap. The obstruction to drainage had caused much more extensive pathology in the right lung (shown by roentgenography and physical signs) as compared to the two preceding cases. Endoscopically the bronchi of the left lung were normal and this was corroborated by the ray and the physical signs both the two last indicating compensatory emphysema. The illustration shows a proximal fibrous stricture covered with granulations. The pus was copious and very foul. Brass much corroded.

Fig 15 Case Fbdy 436b Boy aged 6 years. Peanut kernel projecting from the orifice of the right upper lobe bronchus two days after the kernel was inhaled. Intense diffuse bronchitis which is particularly noteworthy in comparison with the relatively mild and markedly localized inflammation resulting from the presence of foreign bodies other than vegetable substances and especially in comparison with metallic bodies particularly steel. Peroral bronchoscopic removal. Cure.

Fig 16 Case Fbdy 584 Child aged 5 years. Peanut kernels in middle lobe bronchus and an anterior branch of

the inferior lobe bronchus 4 weeks after the accident. Diffuse bronchitis patches of exudate. The pus which was copious has been sponged away. The trachea and the bronchi of the other lung were also inflamed. A younger child would probably have succumbed in less time. Peroral bronchoscopic removal. Cure.

Fig 17 Case 360 P E Man aged 23 years. Bullet probably chiefly led in orifice of left bronchus. Accidentally inhaled a few days previously. Localized bronchitis. Lead not corroded.

Fig 18 Case Fbdy 574 Amalgam tooth filling probably composed of silver tin and mercury in left stem bronchus 2 weeks. Local annular edema possibly due in part to tight impaction of the foreign body. Localized bronchitis. Bronchi of the upper lobe and of the other lung were normal. Peroral bronchoscopic dilatation of annular edema removal of foreign body. Cure.

Fig 19 Case Fbdy 440 Boy aged 14 years. Lead alloy collar button in left inferior lobe bronchus 1 year. Irregular firm fibrous stricture covered with granulations. Bronchiectatic cavity below lined with granulations and filled with very foul pus. The button was somewhat corroded. Stricture dilated and foreign body removed by peroral bronchoscopic removal. Cure.

Fig 20 Case 243 I E Youth of 18 years. Lead alloy collar button in right lung for 10 years. Cicatricial web occluding half of bronchus. At bottom of dilated cavity is the lumen of a firm fibrous stricture. The foreign body was found immediately below this stricture after dilatation. The bronchiectatic cavity below was filled with foul pus. It seems probable that originally the collar button had remained for a long time at the location of the web. Peroral bronchoscopic removal of foreign body. Cure.

NOTE—Figures 7, 19 and 20 afford opportunity for comparison of the effect of short and prolonged sojourn of lead alloys in the bronchi.

Fig 21 Case 5 P F Boy aged 5 years. Steel nail in right main bronchus 1 week. Superficial mild bronchitis. Nail coated thickly with film of corrosion. Peroral bronchoscopic removal. Cure.

Fig 22 Case Fbdy 410 Boy aged 11 years. Steel nail in right stem bronchus 9 1/2 years. Chronic purulent bronchitis of entire right lung. Firm fibrous stricture of very small lumen. Granulations and very foul pus filling cavity below stricture. Nail corroded to a tinder-like mass that pulled apart on traction. Peroral bronchoscopic dilatation of stricture and piecemeal removal of foreign body. Cure.

Fig 23 Case Fbdy 408 Steel nail in right main bronchus about 3 years. Much corroded nail clasped tightly in a bed of fibrous tissue and granulations. Pus very foul. Peroral bronchoscopic removal of nail. Apparent recovery followed 2 months later by death from purulent process in lower thorax or upper abdomen. Postmortem unobtainable.

Fig 24 Case Fbdy 621 Girl aged 4 years. Steel nail in left inferior lobe bronchus 1 month. Bronchitis all over right side due to violent bronchoscopy before admission. Peroral bronchoscopic removal of nail. Cure.

NOTE—Figures 21, 22, 23 and 24 afford opportunity to contrast the effects of steel nails present in the bronchi for periods ranging from 7 days to 9 1/2 years.

Fig 25 Case Fbdy 624 Girl aged 4 years. Pebble in right main bronchus 3 days. Proximal annular edema probably from pressure of tightly impacted smooth round closely fitting body. Localized bronchitis. In a previously reported case of a pebble the conditions were precisely the same. Peroral bronchoscopic extraction. Cure.

Fig 26 Case 266 P E Woman aged 23 years. Brass tag fastener in right lung 7 years. Chronic bronchitis



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## PLATE II

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l l b h p m l C

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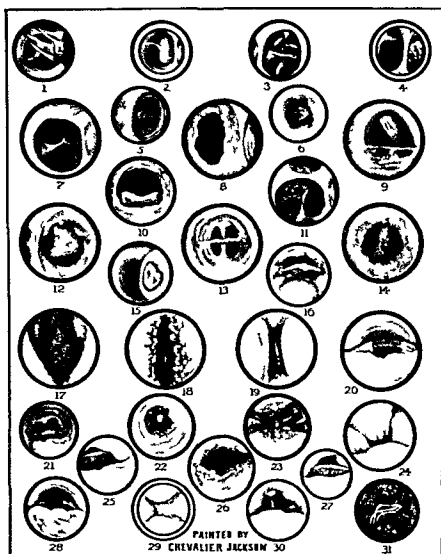


PLATE II



Fig 11 Man aged 37 years Perichondritis of the orifice of the middle lobe bronchus. Unhealed cartilage indicated by the granulations occupying the orifice of an anterior branch of the inferior lobe bronchus in the track of a bullet which passed through the chest 13 months before. This shows the effect of trauma without the continued presence of the foreign body that inflicted it (Perichondritis is often present in case of prolonged sojourn such as 9 14 22 etc.) Recovery after internal administration of small doses of potassium iodide and the use of thromboplastin.

Fig 12 Case Fbdy 623 Man aged 39 years Beef bone impacted in right main bronchial orifice as seen 3 days after aspiration. Acute localized bronchitis due to rough bronchoscopy before admission. The greenish patch of exudate is due to a wound made in a bronchoscopic attempt to remove the bone before admission. The left bronchial orifice is normal and the carina nearly so. Peroral bronchoscopic removal. Cure.

Fig 13 Case Fbdy 310 Woman aged 39 years Chicken bone transfixed in trachea. Contrary to the rule this bone is in the lateral plane. The bone had been in the trachea 6 days yet the reaction is limited to an areola around the points of fixation. This is in marked contrast to the cases of prolonged sojourn such as shown in Figures 10 and 14.

Fig 14 Case Fbdy 608 Man aged 40 years The beef bone had been in the lung 11 years. It is shown beyond a firm fibrous stricture covered with granular inflammation partly epithelialized tissue. Perichondritis. The bone in its crosswise diameter is larger than the stricture but permitted continuous drainage at both sides and the lumen of the stricture was not small which probably accounts for the survival of the patient for so many years in spite of the suppuration. There is a chronic bronchitis throughout right side. Peroral bronchoscopic removal. Cure.

Fig 15 Case Fbly 366 Boy aged 14 years Deciduous molar tooth completely obstructing the orifice of right upper lobe bronchus 2 months after accident. The inflammatory mass in which the tooth was embedded thrown into prominence by strong lateral pressure with the tip of the bronchoscope. Distinctly black and of the other side are not inflamed. Peroral bronchoscopic extraction. Cure.

Fig 16 Case Fbdy 578 Boy aged 3 years Ring of pearl shell (mollusk) in œsophagus for period of over a year. Localized chronic œsophagitis ulceration swollen fold. Foreign body embedded in pocket of inflammatory tissue with granulations at the lateral edges. The shell had whitish incrustation at certain points but whether or not they occurred during the sojourn in the œsophagus could not be determined. Œsophagoscopic extraction. Cure.

Fig 17 Case Fbdy 433 Boy aged 2 years Cockle burr in larynx one day. Moderate acute laryngitis not nearly so severe as one would anticipate from the prickly nature of the foreign body. Extraction. Cure.

Fig 18 Case Fbdy 432 Girl aged 4 years Lead alloy image of a horse in the larynx more than 6 months. Larynx swollen almost shut. Granulation ulceration. Tracheobronchitis was present from the accumulation of secretions due to glottic obstruction and loss of the aid of glottic movement in the bech cycle. Lead alloy partly covered with a colored varnish partly nontoxic. No apparent corrosion.

Fig 19 Case Fbdy 364 Boy aged 4 years Brass safety pin in larynx more than month. Larynx swollen nearly shut. Glottic margin everted. Tracheobronchitis was present from a cumulative accumulation of secretions that could

not be expelled as in preceding case (Fig 18). Brass pin blackened by corrosion.

Fig 20 Case Fbdy 628 Boy aged 1 year Coin (silver half dollar) in œsophagus 5 days. Slight congestion of œsophagus no œsophagitis. The silver surface is bright at the sides where it was clasped in the œsophageal folds. The vertical central line on all surfaces is black with a thick dull corrosion probably sulphides.

Fig 21 Case Fbdy 346 Nursing infant girl aged 6 months Gold filled cuff button partly in trachea and partly in œsophagus (See Fig 8). Button had been swallowed 3 months before and had evidently ulcerated through the party wall into the trachea. The large part of the button being in the œsophagus the stem betwixt the two parts occupying a fistula through the party wall (granulations around the fistula). Tracheobronchitis probably from mother's milk leaking through fistula while taking breast. The metal was corroded in patches. Endoscopic removal. Cure.

Fig 22 Case Fbdy 630 Girl aged 12 years Shoe button (fiber composition with steel eyelet) in left stem bronchus 7 months. Chronic bronchitis limited to left lower lobe bronchus. Granulation formed a bed for the button and obstructed drainage. Some degree of bronchiectasis was noticeable below the button. Fiber unchanged. Steel eyelet corroded. Bronchoscopically removed. Cure.

Fig 23 Case Fbdy 558 Boy aged about 2 years Cast iron jack in œsophagus about 2 months. Œsophagitis inflammatory infiltration granulations (Compare Fig 30). The cast iron was not corroded in the slightest degree in its 2 months sojourn.

Fig 24 Case Fbdy 434 Woman aged 57 years A U shaped bit of tinned wire from an eggbeater in the œsophagus for 5 weeks. The only inflammatory reaction is a small areola around the location where the tooth harp hook shaped point have buried themselves in the mucosa. The wire was not corroded except on point where the tinning was absent. Œsophagoscopic removal. Cure.

Fig 25 Case Fbldv 358 Girl aged 7 years Copper (or bronze) halfpenny (British) in œsophagus 6 hours. No local reaction noted. Congestion (Compare Fig 6). Corroded.

Fig 26 Case Fbdy 309 Girl aged 4 years Copper (or bronze) halfpenny (British) in œsophagus 8 months. Granulation fibrous very small fold (Compare Fig 2). The penny was very much corroded.

Fig 27 Case Fbdy 354 Boy aged 2 years Gold locket in œsophagus 36 hours. No inflammation or congestion. No corrosion.

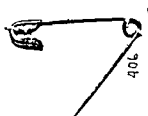

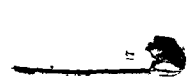
Fig 28 Smea ca sho in Fig 2. The large end of the cuff button is here shown in the anterior all occupies a fistula leading into the trachea. There is a moderate œsophagitis with swollen folds and rough granular mucosa. Peroral endoscopic removal. Cure.

Fig 29 Case Fbdy 590 Girl infant aged 9 months Wool from a blanket in œsophagus many days. No œsophagitis. Mucosa not reddened (Patient a nursing infant and crying). Below the wool there is a mild œsophagitis surrounding 3 other foreign bodies namely fragment of a button a cherry pit and a mass of cotton. All were extracted by œsophagoscopy. Recovery.


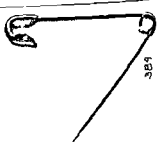
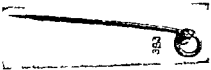

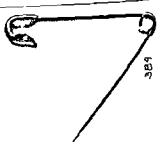
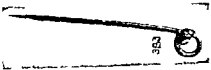
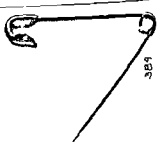
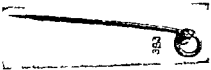
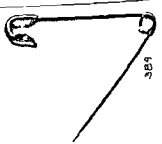
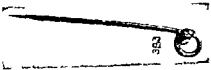
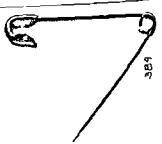
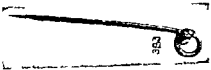
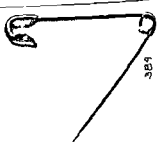
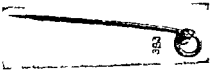
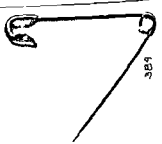
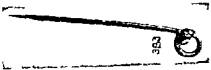
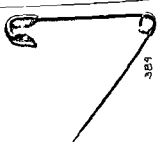
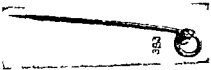
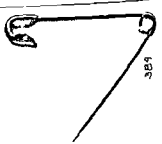
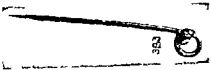
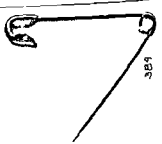
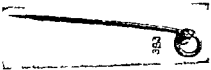
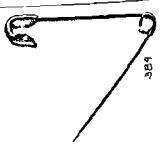
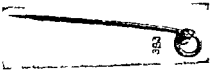
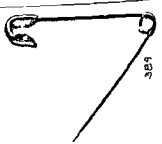
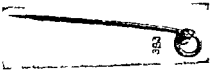
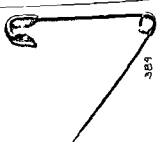
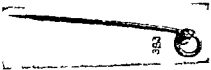
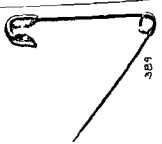
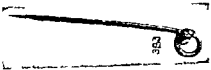
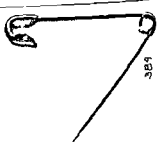
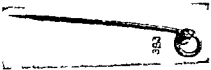
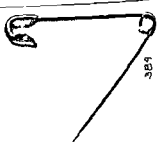
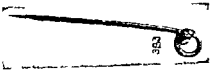
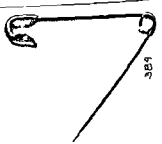
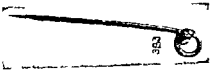
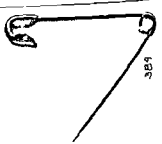
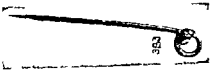
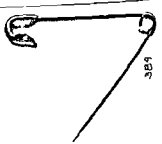
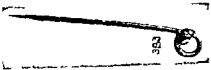
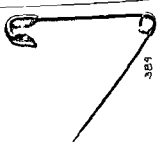
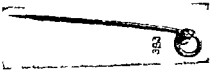
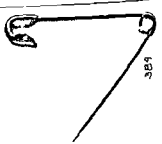
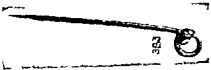
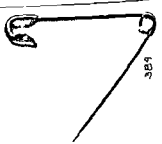
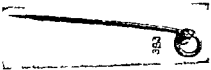
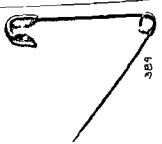
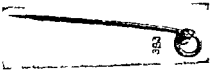
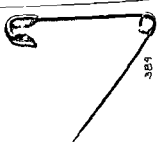
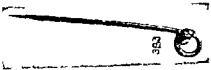
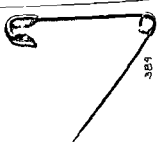
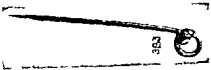
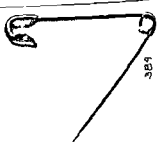
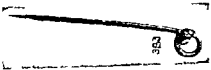
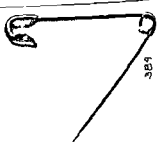
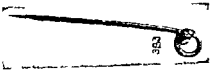
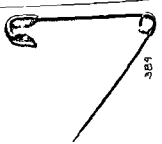
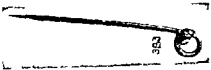
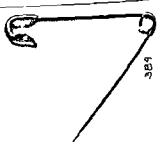
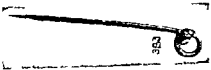
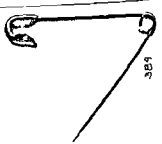
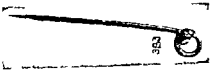
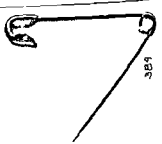
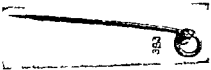
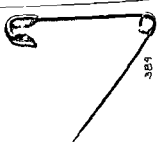
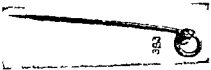
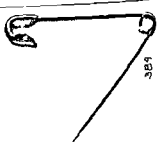
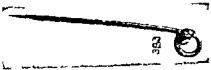
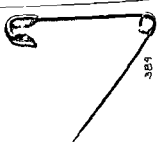
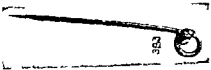
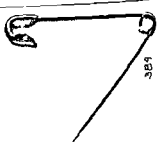
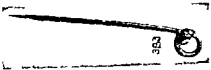
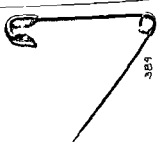
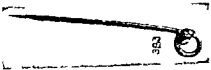
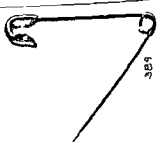
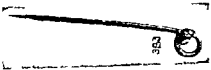
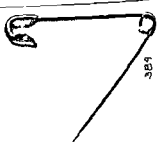
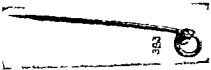
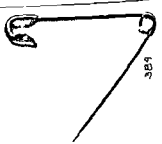
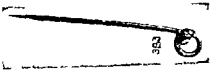
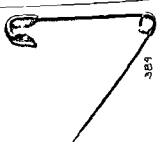
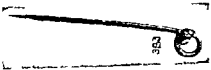
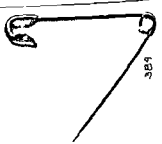
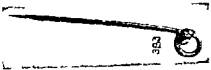
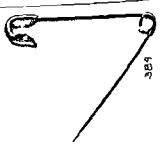
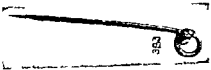
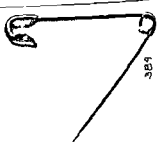
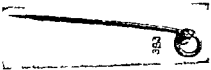
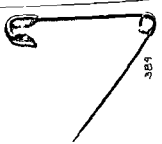
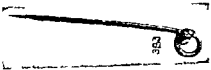
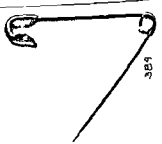
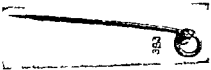
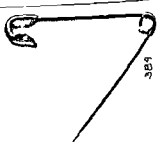
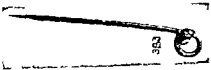
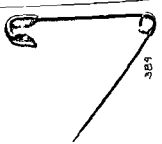
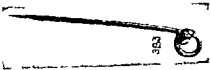
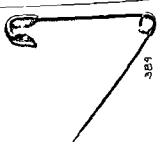
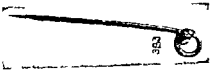
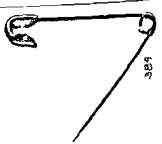
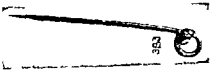
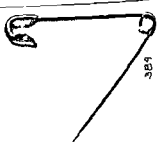
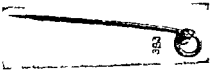
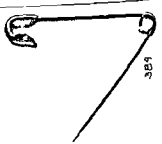
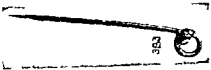
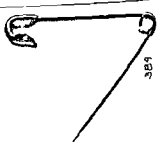
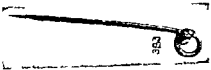
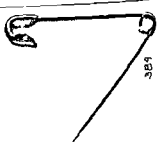
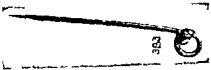
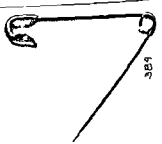
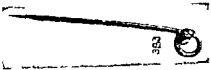
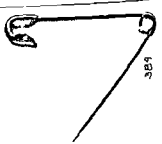
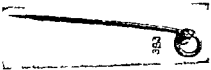
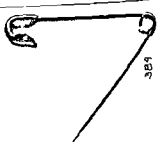
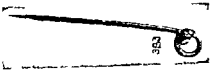
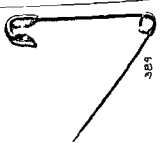
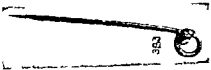
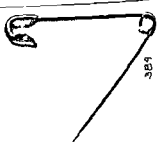
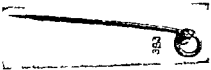
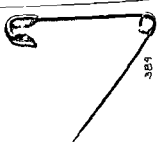
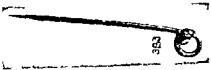
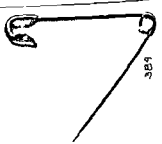
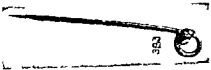
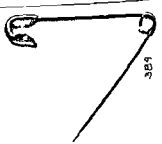
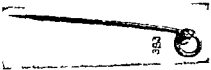
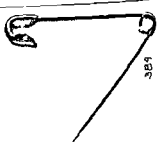
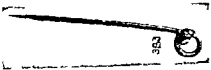
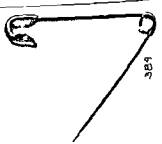
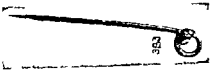
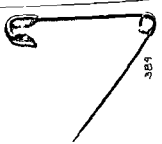
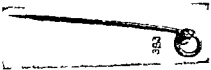
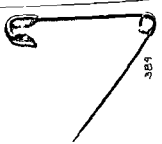
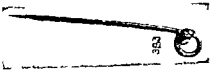
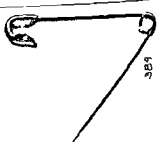
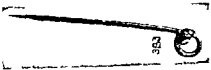
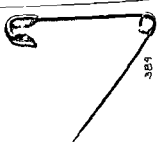
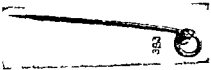
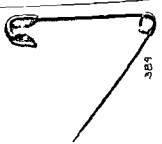
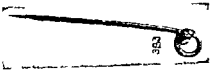
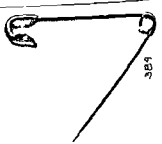
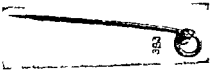
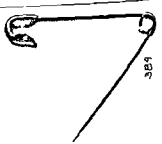
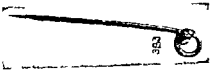
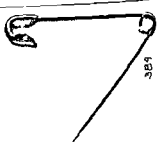
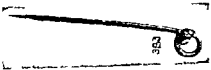
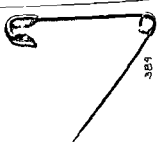
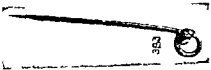
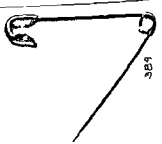
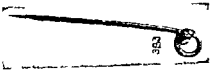
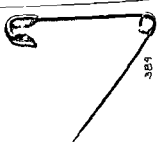
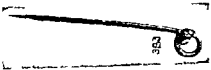
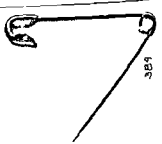
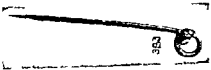
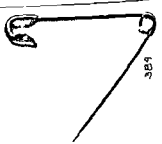
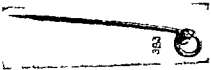
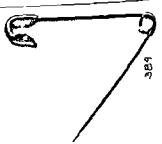
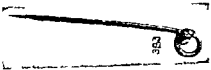
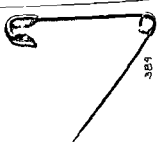
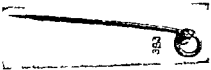
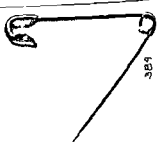
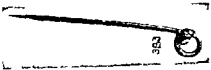
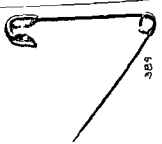
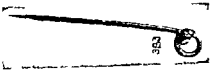
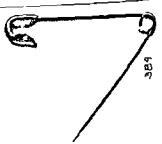
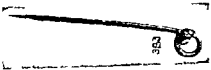
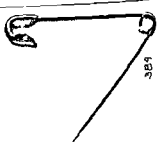
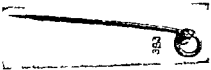
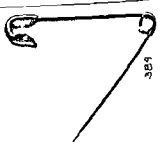
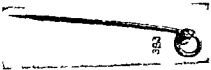
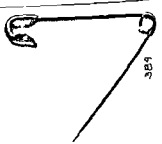
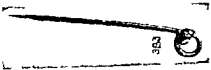
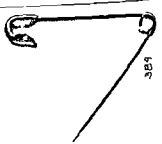
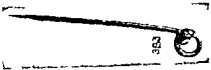
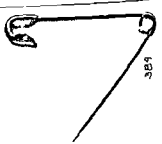
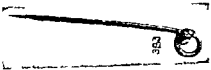
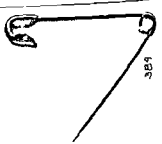
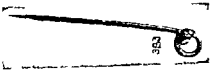
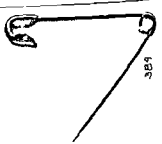
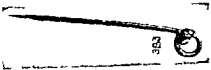
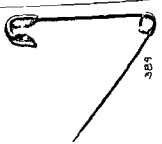
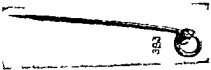
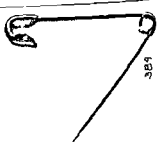
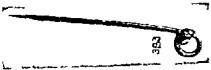
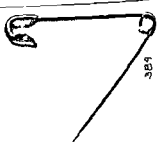
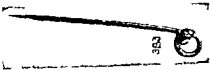
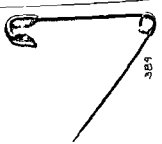
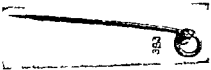
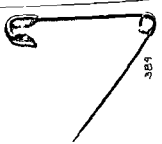
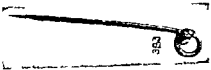
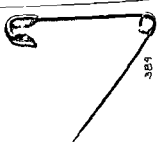
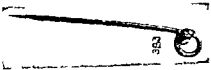
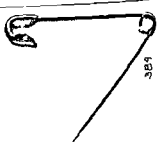
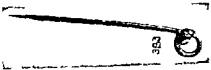
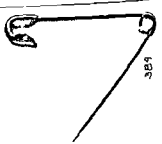
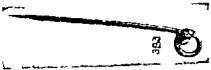
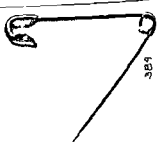
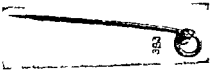
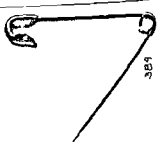
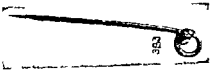
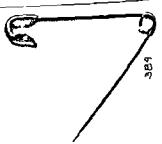
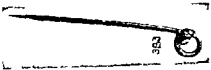
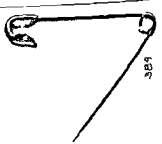
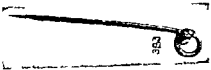
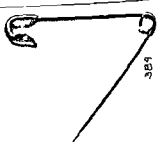
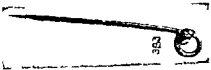
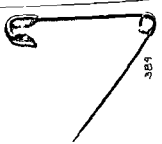
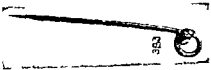
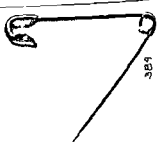
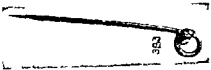
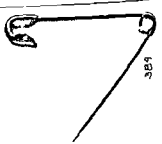
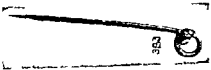
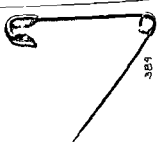
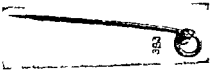
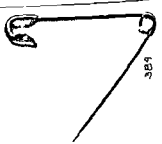
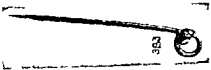
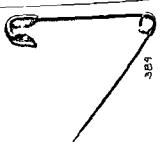
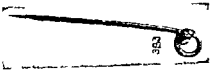
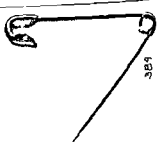
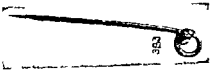
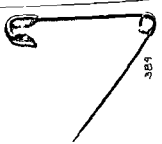
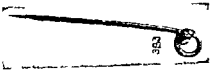
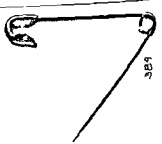
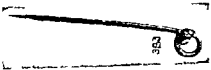
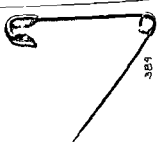
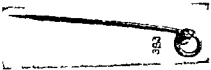
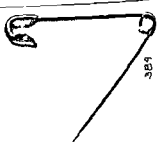
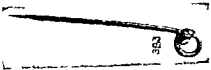
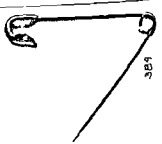
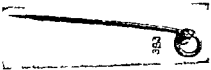
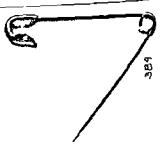
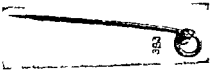
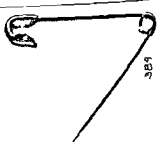
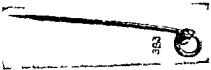
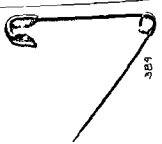
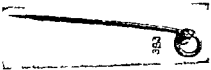
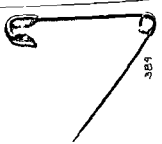
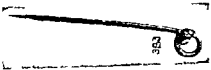
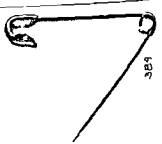
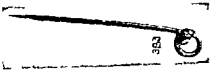
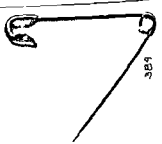
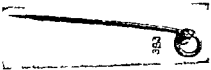
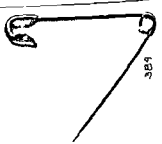
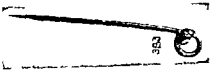
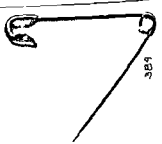
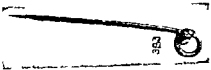
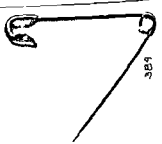
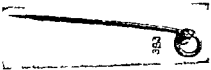
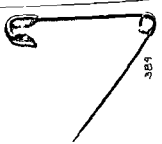
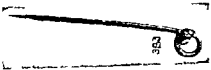
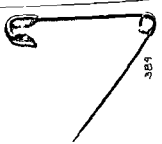
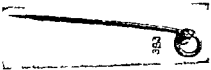
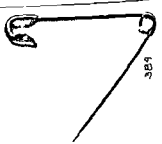
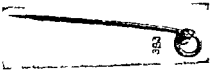
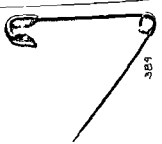
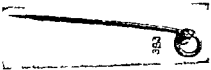
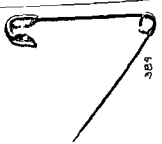
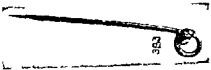
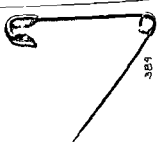
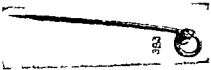
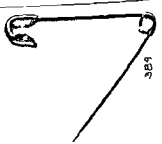
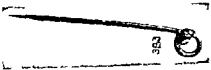
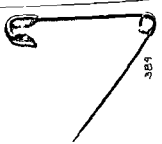
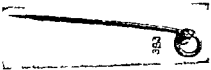
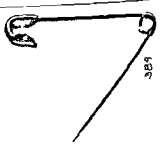
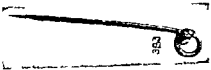
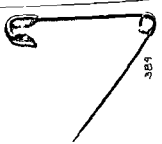
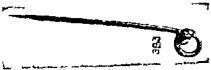
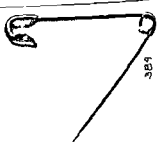
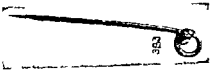
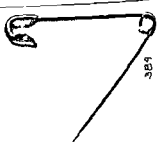
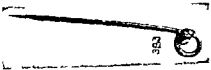
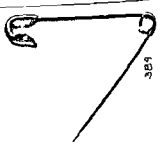
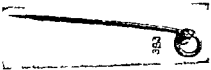
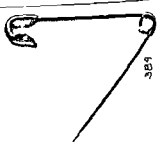
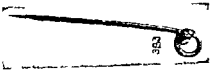
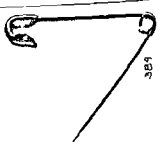
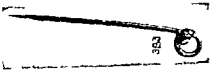
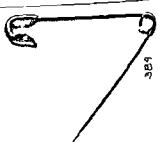
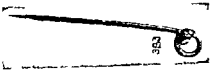
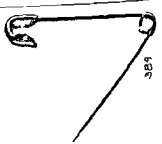
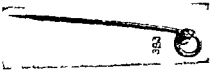
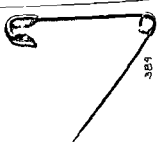
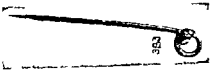
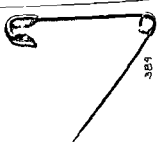
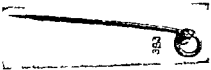
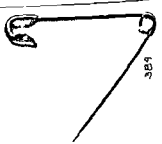
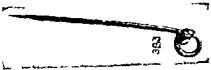
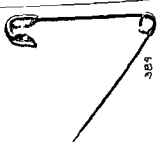
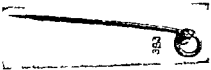
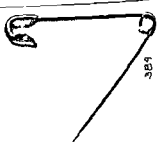
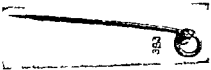
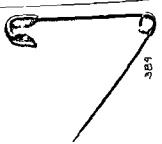
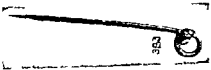
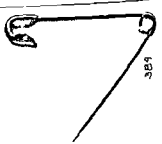
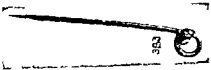
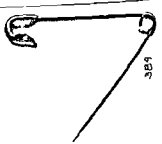
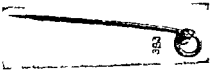
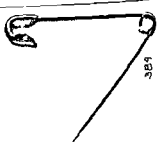
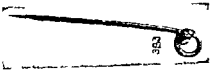
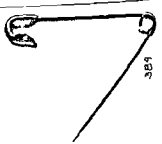
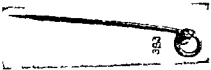
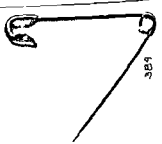
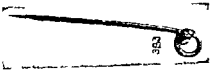
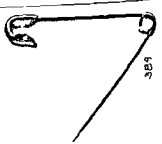
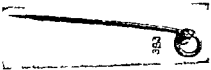
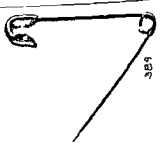
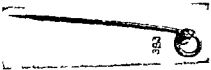
Fig 30 Case 341 Infant 1 months old Cast iron jack in œsophagus weeks. No œsophagitis. Slight congestion (Compare Fig 3). No corrosion of the cast iron. Pharyngeal copic tract. Cure.


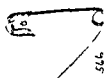

Fig 31 Case 93 Boy 13 years Probang in trachea in œsophagus 7 days. Intestinal œsophagitis due to use of probang before admission. To the right are sections of linear abrasions covered with exudate.

| Age | Sex | Body   | Head   | Neck   | Thorax | Abdomen | Genitalia | Rectum | Stomach | Intestines | Urinary | Respiratory | Circulatory | Nervous | Mental | General |
|-----|-----|--------|--------|--------|--------|---------|-----------|--------|---------|------------|---------|-------------|-------------|---------|--------|---------|
| 20  | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |
| 25  | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |
| 30  | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |
| 35  | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |
| 40  | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |
| 45  | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |
| 50  | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |
| 55  | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |
| 60  | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |
| 65  | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |
| 70  | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |
| 75  | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |
| 80  | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |
| 85  | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |
| 90  | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |
| 95  | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |
| 100 | F   | Normal | Normal | Normal | Normal | Normal  | Normal    | Normal | Normal  | Normal     | Normal  | Normal      | Normal      | Normal  | Normal | Normal  |

|       |   |   |                  |                     |   |             |                                |            |            |              |      |     |  |
|-------|---|---|------------------|---------------------|---|-------------|--------------------------------|------------|------------|--------------|------|-----|--|
| N 46  |   | m | S (lyl<br>pe     | L D s h m<br>po t p | N | L D s<br>pe | Ope<br>po t p<br>mbedd d       | All g t    | N<br>t t d | E t t<br>C   | 6 ec | O l | V ry light col   |
| N 566 |  | > | S (lyl<br>pe     | L D s h m<br>po t p | N | L D s<br>pe | V d<br>t uen by<br>po t        | All g t    | N<br>t t d | E t t<br>C   |      | O l | S ight l p m t d<br>m g t b t d f m o<br>m ft fl th pa m |
| N 67  |  | > | S (lyl<br>(part) | Left b h<br>7 m th  | N | 5 mm        | E l hook d<br>p l m f b<br>l b | S l<br>r d | E d        | E tra t<br>C | m    | O l | B h t g l m o<br>l s d t p bo t                          |

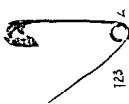


SAFETY PINS

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
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| <br>Fig | <br>384 | <br>385 | <br>386 | <br>387 | <br>388 | <br>389 | <br>390 | <br>391 | <br>392 | <br>393 | <br>394 | <br>395 | <br>396 | <br>397 | <br>398 | <br>399 | <br>400 | <br>401 | <br>402 | <br>403 | <br>404 | <br>405 | <br>406 | <br>407 | <br>408 | <br>409 | <br>410 | <br>411 | <br>412 | <br>413 | <br>414 | <br>415 | <br>416 | <br>417 | <br>418 | <br>419 | <br>420 | <br>421 | <br>422 | <br>423 | <br>424 | <br>425 | <br>426 | <br>427 | <br>428 | <br>429 | <br>430 | <br>431 | <br>432 | <br>433 | <br>434 | <br>435 | <br>436 | <br>437 |

<br>438 | <br>439 | <br>440 | <br>441 | <br>442 | <br>443 | <br>444 | <br>445 | <br>446 | <br>447 | <br>448 | <br>449 | <br>450 | <br>451 | <br>452 | <br>453 | <br>454 | <br>455 | <br>456 | <br>457 | <br>458 | <br>459 | <br>460 | <br>461 | <br>462 | <br>463 | <br>464 | <br>465 | <br>466 | <br>467 | <br>468 | <br>469 | <br>470 | <br>471 | <br>472 | <br>473 | <br>474 | <br>475 | <br>476 | <br>477 | <br>478 | <br>479 | <br>480 | <br>481 | <br>482 | <br>483 | <br>484 | <br>485 | <br>486 | <br>487 | <br>488 | <br>489 | <br>490 | <br>491 | <br>492 | <br>493 |

<br>494 | <br>495 | <br>496 | <br>497 | <br>498 | <br>499 | <br>500 | <br>501 | <br>502 | <br>503 | <br>504 | <br>505 | <br>506 | <br>507 | <br>508 | <br>509 | <br>510 | <br>511 | <br>512 | <br>513 | <br>514 | <br>515 | <br>516 | <br>517 | <br>518 | <br>519 | <br>520 | <br>521 | <br>522 | <br>523 | <br>524 | <br>525 | <br>526 | <br>527 | <br>528 | <br>529 | <br>530 | <br>531 | <br>532 | <br>533 | <br>534 | <br>535 | <br>536 | <br>537 | <br>538 | <br>539 | <br>540 | <br>541 | <br>542 | <br>543 | <br>544 | <br>545 | <br>546 | <br>547 | <br>548 | <br>549 |

<br>550 | <br>551 | <br>552 | <br>553 | <br>554 | <br>555 | <br>556 | <br>557 | <br>558 | <br>559 | <br>560 | <br>561 | <br>562 | <br>563 | <br>564 | <br>565 | <br>566 | <br>567 | <br>568 | <br>569 | <br>570 | <br>571 | <br>572 | <br>573 | <br>574 | <br>575 | <br>576 | <br>577 | <br>578 | <br>579 | <br>580 | <br>581 | <br>582 | <br>583 | <br>584 | <br>585 | <br>586 | <br>587 | <br>588 | <br>589 | <br>590 | <br>591 | <br>592 | <br>593 | <br>594 | <br>595 | <br>596 | <br>597 | <br>598 | <br>599 | <br>600 | <br>601 | <br>602 | <br>603 | <br>604 | <br>605 |

<br>606 | <br>607 | <br>608 | <br>609 | <br>610 | <br>611 | <br>612 | <br>613 | <br>614 | <br>615 | <br>616 | <br>617 | <br>618 | <br>619 | <br>620 | <br>621 | <br>622 | <br>623 | <br>624 | <br>625 | <br>626 | <br>627 | <br>628 | <br>629 | <br>630 | <br>631 | <br>632 | <br>633 | <br>634 | <br>635 | <br>636 | <br>637 | <br>638 | <br>639 | <br>640 | <br>641 | <br>642 | <br>643 | <br>644 | <br>645 | <br>646 | <br>647 | <br>648 | <br>649 | <br>650 | <br>651 | <br>652 | <br>653 | <br>654 | <br>655 | <br>656 | <br>657 | <br>658 | <br>659 | <br>660 | <br>661 |

<br>662 | <br>663 | <br>664 | <br>665 | <br>666 | <br>667 | <br>668 | <br>669 | <br>670 | <br>671 | <br>672 | <br>673 | <br>674 | <br>675 | <br>676 | <br>677 | <br>678 | <br>679 | <br>680 | <br>681 | <br>682 | <br>683 | <br>684 | <br>685 | <br>686 | <br>687 | <br>688 |
|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|--|

|         |   |    |                 |                                   |   |                 |                             |            |                    |               |         |      |   |
|---------|---|----|-----------------|-----------------------------------|---|-----------------|-----------------------------|------------|--------------------|---------------|---------|------|---|
| 46<br>N |   | m  | tyl<br>pc       | Laryng<br>f t p                   | N | Laryng<br>sc pe | Open<br>po t p<br>mob d d l | All g t    | N<br>p t<br>t d    | E t t<br>C re | 6       | O l  | ry light  |
| 47<br>N |  | y  | tyl p<br>pc     | Laryng<br>d s<br>l l tu<br>po t p | N | Laryng<br>pe    | A t<br>t m<br>p t           | All g t    | N<br>po t<br>t d l | F t t<br>C    | ec      | Oral | Slight<br>m t<br>t ted<br>f m<br>x t beca<br>f ph<br>th fl<br>th pin an<br>m th |
| 48<br>N |  | 33 | tyl p<br>(part) | Left b<br>7 m th                  | N | 5 mm            | E d h<br>t b<br>p b         | S f<br>m d | E d                | F t t<br>C re | m<br>ec | O l  | B l t<br>l s<br>d t p   |





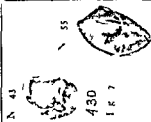
|   |     |                          |  |          |                            |                                  |                |                           |                         |            |             |   |
|---|-----|--------------------------|--|----------|----------------------------|----------------------------------|----------------|---------------------------|-------------------------|------------|-------------|---|
|  <p>43</p> <p>123</p> <p>Fig 1</p>  | 7 m | <p>sf ty p<br/>pe</p>    | <p>phagu point p<br/>o h</p>               | <p>N</p> | <p>Laryng<br/>pe</p>       | <p>Op<br/>po<br/>p<br/>bed d</p> | <p>All g t</p> | <p>Near p t</p>           | <p>E tra t<br/>C</p>    | <p>Sec</p> | <p>Oral</p> | <p>Sight gest</p>   |
|  <p>43</p> <p>430</p> <p>Fig 2</p> | m   | <p>sf ty p<br/>pe</p>    | <p>roph gu po t<br/>p o h rs</p>           | <p>N</p> | <p>Lary<br/>pe</p>         | <p>Op<br/>po<br/>t p</p>         | <p>All g t</p> | <p>N po t</p>             | <p>E tra t<br/>C re</p> | <p>ec</p>  | <p>O l</p>  | <p>M oca<br/>db<br/>rm l<br/>i po t<br/>pt</p>                      |
|  <p>76</p> <p>576</p> <p>Fig 3</p> | 376 | <p>S f ty pun<br/>pe</p> | <p>ph gu bel w<br/>ri pl rj<br/>o h rs</p> | <p>N</p> | <p>Laryng<br/>pe<br/>m</p> | <p>Op<br/>po<br/>t p</p>         | <p>All g t</p> | <p>Spun g d<br/>ft rs</p> | <p>F t t<br/>C re</p>   | <p>s</p>   | <p>O l</p>  | <p>M<br/>m l i<br/>t t l<br/>pp tly<br/>i by l<br/>m th t<br/>g</p> |



|        |                           |                         |       |      |   |                                     |                   |                  |            |     |   |
|--------|---------------------------|-------------------------|-------|------|---|-------------------------------------|-------------------|------------------|------------|-----|---|
| 8 yrs  | B t m t<br>t t th<br>cr n | Rt t m b<br>l t<br>days | Loc l | 7 mm | T g ry  | St ght                              | Fl t is<br>t t g  | E t t<br>C       | m<br>56 ec | O l | L o l d mod<br>b h t  |
| 3      | B a. p                    | Rt b h<br>43            | N     | 5 mm | Food g  |                                     |                   | C old t<br>b f d |            | O l | C p rem d by th t my  |
| 43     | B l                       | T hea bgl tt            | N     | 5 mm | T m g   | S d cu j                            | E lge ft<br>t ung | E t t<br>C       | m<br>56 ec | O l | T m t t h t l<br>t t ry t m m<br>t t t t t t t t<br>w l t t t t t t<br>7 d y                |
| 9 yrs  | B p                       | Rt b h<br>3 rs          | N     | 7 mm | H ll w<br>d g<br>b n d                                | Pl pe l                             | I d d<br>t d d    | E tra t<br>C     | m<br>53    | O l | P um l r<br>l t t t t p (F g 4<br>Pl t t)   |
| 53 yrs | At m x r t p<br>l d       | Rt t m b<br>3 rs        | Loc l | 9 mm | H ll w<br>h r p<br>d d g<br>p w f b<br>t t t<br>t t t | t ght<br>t ft<br>t b t g<br>d g e a | S l               | E tra t<br>C re  | m<br>55 ec | O l | P um l r b t et<br>t t t t t t t t<br>d t t t t t t t<br>t t t t t t t t<br>t t t t t t t t |



Fig 6



430

I R 7



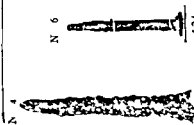
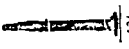
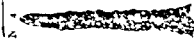



572





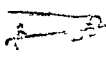

576




576



|  |  |        |                           |                          |       |   |              |                                       |                   |                           |            |             |     |   |
|--|--|--------|---------------------------|--------------------------|-------|---|--------------|---------------------------------------|-------------------|---------------------------|------------|-------------|-----|---|
|  <p>N 4</p>    |  <p>N 6</p> | 3 yrs  | N 1                       | Rt m<br>9 1/2 y          | N b h | N | 7 mm         | Fr b l y<br>f m<br>o e t t            | St ght            | G d<br>by b t             | E t t<br>C | 3 m         | O l | G l t<br>ty f l l d th f l<br>p (F g Pl t l)                                      |
|  <p>F 7</p>    |  | 43 yrs | N 1                       | L ft m l b<br>m th       | N b h | N | 5 mm         | T f<br>h d<br>h red l n<br>b h<br>n f | S l r v d         | P f t<br>d s m<br>b d d d | E t t<br>C | m           | O l | B b t l l<br>h ght b h<br>m l (F g 4 Pl t l)                                      |
|  <p>N 30</p>  |  | 43 yrs | F l<br>l b l<br>p o t l   | P t b h r t<br>l b s d y | Local |   | 7 mm<br>45 m | P t d<br>b ed<br>p m l<br>e d m       | S d r v d<br>Hook | C r d d<br>f t m g        | E t t<br>C | h<br>4 m    | O l | Loc l d<br>l t p t f<br>m l s a by p o t p<br>m l e d m<br>(F g Pl t l)           |
|  <p>N 400</p> |  | 43 yrs | S f l<br>d b l<br>p o t d | L f t m a n b<br>y r a   | Loc l |   | 9 mm         | P t d<br>P d                          | S d r v d<br>H k  | C r d d<br>f t g          | F t t<br>C | h<br>m      | O l | G l t<br>f l m<br>m l y f u l p<br>t m f m b h s<br>p y d l<br>m s (l g 8 Pl t l) |
|  <p>N 55</p>  |  | >      | f t g                     | Rt m a n b<br>3 d y      | N b h | N | 6 m          | C m o o d h                           | S d c u d         | S m l l d<br>f t          | E t t<br>C | 6 m<br>5 ec | O l | Lo l a d b<br>5 Pl t l  |
|  |  |        |                           |                          |       |   |              |                                       |                   |                           |            |             |     |   |

## JEWELRY

| C N ml 3   | A | F Bod         | Loc                        | A h | T b      | P ll m                      | J n l    | P f        | R l      | T m      | K    | R m k  |
|--|---|---------------|----------------------------|-----|----------|-----------------------------|----------|------------|----------|----------|------|--|
|   | 4 | C ll b<br>l d | l f f l be t<br>h y r      | N   | m        | re<br>l                     | J<br>n l | By pos     | E<br>l   | m<br>sec | O l  | F eml ml ll d<br>l h ac<br>f l l l h<br>l l l l h<br>l l l l h |
|   | m | C ll b<br>b   | top h au l l<br>l h u r ge | N   | La<br>ac | La ge<br>re                 | Al       | Pos f<br>n | E m<br>l | sec      | Oral | l l l l h<br>f h<br>mool l bod                                 |
|   | m | B             | l f f l be b<br>h oct      |     | mm       |                             |          |            |          |          |      | R m d pos m m  |
|  | m | l l ll l l    | l f f l be b<br>h oct      | N   | mm       | J<br>n l<br>ll m<br>f l l l | J<br>n l | ll f       | f        | m        | l    | Loc l sec h<br>l f e l l t po<br>d d l l l                     |

|   |     |   |      |   |                            |     |      |                                       |                                 |                                  |     |                          |                                 |              |     |                                      |                                       |
|---|-----|---|------|---|----------------------------|-----|------|---------------------------------------|---------------------------------|----------------------------------|-----|--------------------------|---------------------------------|--------------|-----|--------------------------------------|---------------------------------------|
|  <p>N 56</p> <p>Fig 56</p>  | m   | B | ph r | N | L                          | g p | V    | d<br>i load<br>m t<br>deepe<br>pa sag | M                               | g t                              | P   | E t<br>C re              | 6 sec                           | O l          | A t | E t                                  |                                       |
|  <p>N</p> <p>Fig 57</p>    | 4 m | B | p l  | L | ft b                       | h   | N    | 4 mm                                  | V                               | h ed<br>pe po t<br>p m ll<br>b h | P   | it<br>be t<br>p be       | E l ft<br>loc<br>th g t<br>p be | 4 m<br>5 sec | O l | P                                    | t m g<br>f rem body<br>h m<br>py<br>m |
|  <p>N 56</p> <p>Fig 58</p> | m   | B | ooc  | U | ph gu bel w<br>ph r<br>4 l | N   | 7 mm | P                                     | t g<br>rat<br>po t<br>d t<br>dg | R                                | t t | E t t<br>pe m t<br>rot t | 35                              | O l          | L   | t loc<br>leg<br>t loc<br>t loc<br>ph |                                       |



| C. ce<br>mbe<br>d | Ag   | F re gn<br>Hood | Loca                | T be  | I l l m                 | F n p     | P re      | Re l       | F m   | R    | k m l                      |
|-------------------|------|-----------------|---------------------|-------|-------------------------|-----------|-----------|------------|-------|------|----------------------------|
|                   | 6    | 1               | Pos<br>l u<br>d     | L a g | F<br>l l<br>f           | All       | N l       | F re       | g sec | nal  | lred l mm l                |
| N 86              |      |                 |                     |       |                         |           |           |            |       |      |                            |
|                   | yrn  | P               | L a y n m h         | L a g | f h h k<br>h            | All       | N pe      | F re       | man   | O l  | f re h d<br>r y re l a l m |
|                   |      |                 |                     |       |                         |           |           |            |       |      |                            |
| N 57              | 83 m | P               | B se<br>m g e l r o | L a g | E ract<br>h<br>l re l g | All g or  | N pe      | E ct<br>re | sec   | On l | l h areol s                |
|                   |      |                 |                     |       |                         |           |           |            |       |      |                            |
|                   |      | P d l<br>be     | T h h               | L a g | T h p<br>l a s          | All       | N po      | F ct       | sec   | O l  | l h co l                   |
|                   |      |                 |                     |       |                         |           |           |            |       |      |                            |
|                   | 8 m  | h l             | Lef l               | mm    | I d<br>m                | I cu<br>j | N h b l l | E c        | m     | O l  | f<br>m<br>be               |

|       |         |   |       |                      |                                       |              |                |              |                    |      |  |  |
|-------|---------|---|-------|----------------------|---------------------------------------|--------------|----------------|--------------|--------------------|------|--|--|
| 8 yrs | Sh 1 p  | H d<br>t b<br>1 ft m<br>d y               | N     | 7 mm                 | P t b<br>t h<br>l                     | S d<br>r d   | N              | po t<br>C    | E t t<br>C         | 6 m  | O l  | Harm rth g f m p<br>po t p t (F g s<br>Pl t l) |
| 6 yrs | Sha 1 p | Absces<br>t b<br>y t<br>g h t m<br>s s rs | Loc 1 | C so<br>b h<br>se pe | F d g<br>p<br>rroded<br>rumbling<br>p | N l l<br>d d | As p<br>t d    | E tract<br>C | 37 m<br>4 m<br>7 m | O l  | Absces m t pe<br>d p int f<br>bees f d with g<br>t t d h y b d<br>f t us y b d<br>l g 7 Pl t l |  |
| 7 yrs | Sh 1 p  | L ft b<br>5 m th                          | N     | 7 mm                 | T f d                                 | l rved       | N ea po t<br>C | F t t<br>C   | 3 m<br>3 ec        | Oral | Loc 1 ed h b<br>h t m d l k<br>g d b d po t<br>(F g 4 Pl t l)                                  |  |
| 7 y   | Sh 1 p  | Left t<br>t b                             | N     | 7 mm                 | N                                     | d<br>r d     | N po t<br>C    | E t t<br>C   | 5 ec               | O l  | S plit<br>f p t<br>(F g Pl t l)  |  |
| 4 y   | Sh 1 p  | Larv ph rym<br>4 h                        | N     | Larv pe              | N                                     | All g t      | N pe t<br>C    | E tra t<br>C | 5 m                | O l  | S g l g t m t ex ph<br>f g t f m t t mpt<br>t dm   |  |
| 4 yrs | Sh 1 p  | H b r t h<br>l y                          | N     | L o g<br>pe          | T f<br>l l<br>l                       | All t        | N po t<br>C    | E t t<br>C   | 3 ec               | Oral | R d re l hoo t m<br>d m t d b l<br>pe t  |  |

N 569

I R 45

N 66

- 616

I R 47

N 75

548

545

I R 44

N 577

577





I R 46

N 30

547

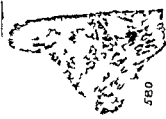


I R 3






|   |       |                 |                                 |   |                |   |                        |                       |            |              |      |   |
|---|-------|-----------------|---------------------------------|---|----------------|---|------------------------|-----------------------|------------|--------------|------|---|
|  <p>582<br/>F 51</p>  | 3     | Ch k bo         | (f ph g t b<br>hail g o<br>f y) | N | mm             | N | St ght<br>d j<br>r v i | Fit<br>t g            | F t t<br>C | (m<br>pp)    | O l  | Loc l d α ph t<br>t t t p t<br>t d s          |
|  <p>377<br/>F 54</p> | 3rs   | Ch k bo         | Laryn d y                       | N | L d g<br>s c f | N | All g t                | Fit                   | E t t<br>C |              | O l  | R i t ly l ght t l<br>t                       |
|  <p>385<br/>F 55</p> | 3rs   | Ch k l          | R h b h t t<br>g y              | N | 3 mm           | N | St ght                 | Sm ll d               | E t t<br>C | 3 m<br>3 s e | O l  | B t loose b b ec<br>p t II) (g                |
|  <p>390<br/>F 56</p> | 3 3rs | Ch k b<br>l m t | Uroph bel<br>ph r g<br>d y      | N | mm             | N | St ght<br>h m l<br>poo | F t ed<br>p rt {<br>b | E t t<br>C | m<br>y ec    | Oral | (f ph gu d p c<br>m t p l h m l<br>d y ft m l |

## BONFS—Continued

[illegible]

|  |     |         |                             |   |      |   |            |     |            |             |     |  |
|--|-----|---------|-----------------------------|---|------|---|------------|-----|------------|-------------|-----|--|
|  <p>580</p>  | 43  | Reef bo | Esoph g l l<br>4 d y ph r g | N | mm   | h pe<br>l f t                                 | R ll g t   | FJ  | F t t<br>C | 3 m<br>5 cc | O l | <p>B p t d h d f<br/>f l l m d t l<br/>er ph et loc l m l<br/>m p h m g l</p>                          |
|  <p>64</p>  | 683 | B f bo  | Esoph g l l<br>3 ph g th t  | N | 9 mm | La x l p<br>h f<br>body<br>tightly<br>m p a d | R t t      | H t | E t t<br>C | 3 m<br>5 cc | O l | <p>L n t l f d t<br/>t p l q f d t<br/>loc l r m d p t<br/>r y f l a m m t r y<br/>d f b l l t m c</p> |
|  <p>386</p> | 538 | l l l   | L b f l l e<br>b h s eck    | N | 7 mm | N   | S J<br>r f | H t | F t t<br>C | 3 m<br>5 cc | O l | <p>Loc l f l h t m<br/>p (l b 3 l l t H)</p>   |





## BONES—Continued

| C. N. m. d.   | Age | F. Bod. | Loca.        | h. | 7. Is. | P. bl. m. | J. n. po. | P. Se. | Res. l. | T. m. | R. t. | R. m. l.   |
|---|-----|---------|--------------|----|--------|-----------|-----------|--------|---------|-------|-------|--|
|  | m   | t h bo  | R h m laro h | h  | mm     | h         | h         | h      | E re    | m     | l     | L a l l h h<br>h re ) re t g   |
|  | Ad  | t h bo  | L a h h      | h  | h      | h         | h         | h      | E re    | m     | h     | h h loc lard re  |
|  | re  | t h bo  | L a h h      | h  | mm     | h         | h         | h      | E re    | m     | h     | L l m m t p h g<br>re d t re h g<br>h h p f bo<br>f l l o d<br>m b e d l d p e |

## SEEDS NUTS SHELLS ETC



| h | T h | d | mm | C. m. s. e. | h | se | re | sec | O | m | so |
|---|-----|---|----|-------------|---|----|----|-----|---|---|----|
|---|-----|---|----|-------------|---|----|----|-----|---|---|----|





|   |       |                                   |                                      |   |   |      |                               |        |                    |             |           |     |   |
|---|-------|-----------------------------------|--------------------------------------|---|---|------|-------------------------------|--------|--------------------|-------------|-----------|-----|---|
| 38<br><br>380<br>I g 68   | 3 m   | P <sub>k</sub> t <sub>l</sub>     | Right b <sub>l</sub> y               | h | N | 4 mm | F g l                         | St ght | A p <sub>t</sub> l | F t t       | 3 ec      | O l | I f t h b h t<br>p e t h d l f m y<br>t h k f t g<br>h p t l d d f b<br>h p m |
| 402<br>I g 62   | 3 yrs | P <sub>k</sub> t <sub>l</sub> m l | Left t m b h<br>3 d y                | h | N | 5 mm | F g l                         | St ght | A p <sub>t</sub> l | F t t<br>C  | 6 m<br>ec |     | D f f b h t h<br>l g d l d<br>h d d g f h                                     |
| 430<br><br>4378<br>I g 7 | 6 yrs | P <sub>k</sub> t <sub>l</sub>     | Right m h<br>h                       | h | N | 5 mm | F g l                         | St ght | E d n t            | F t t<br>C  | 3 m       | O l | I t a e d f h b t<br>(h g 5 l t l)  |
| 45<br><br>45<br>I g 7    | 3     | P <sub>k</sub> t <sub>l</sub>     | Left m b h<br>4 d y                  | h | N | 5 mm | F g l                         | St ght | A p e<br>t d       | E t et<br>C | m         | O l | D f f b h t b o t h<br>d p k p  |
| 573<br><br>57<br>I g 7   | 5 yrs | P <sub>k</sub> t <sub>l</sub> m l | Right f l be<br>b h 3 p e e s<br>1 y | h | N | 5 mm | 3 f g m t<br>d i f<br>l o c t | St ght | A p e<br>t d       | E t et<br>C | 9 m<br>ec | O l | D f f e t h b h t<br>t m p  |

























## SEEDS NLTS SHFILS LTC -Continued

| Cat's name & Ill  | A      | Fur Body                                   | Loc  | A h | T le | P lid m              | I re pa | I y re         | R l  | T m   | K   | R m k  |
|---|--------|--|--|-----|------|----------------------|---------|----------------|------|-------|-----|--|
| N 58<br><br>589 I 73 | 53     | P km l                                     | M d d l l l e l f<br>d i t b h f<br>l b e l h<br>all | N   | mm   | l m<br>l d<br>l ea   | b       | A j re<br>e ed | E    | m     | O l | l ff se b h m h<br>m m i h som<br>pa tes f g j Pl                      |
| N 60<br><br>I 74     | 3 yrs. | P km l                                     | k h m l f f f<br>l b e b h                           | N   | mm   | l m l<br>l m         | ra h    | A re l         | f re | m sec | ral | D ff se ra hook h<br>ss f h li et<br>ed by h li<br>  hee m ( m ll<br>h |
| N 61<br><br>I 75     | 8 yrs  | P h R<br>(neck h R<br>f la ) )<br>f la ) ) | Lef f f f f f<br>leo h h<br>d s                      | N   | mm   | r m<br>r re<br>f d l | ra f    | ll f           | f re | m sec | O l | R hu l m l l l e<br>se if s p f m<br>f m f f h f m<br>l ly i mp l      |
| N 62<br><br>I 76     | m      | V l m l                                    | R gh l ach<br>pe da                                  | N   | mm   | l                    | d cu d  | A re d         | E et | m     | O l | re l se bro m)<br>w (  |






|   |     |                   |                           |   |                |  |           |                      |                |              |     |   |
|---|-----|-------------------|---------------------------|---|----------------|--|-----------|----------------------|----------------|--------------|-----|---|
| 376<br> | yr  | W t r m l<br>d    | Left t m l<br>d d y p h d | N | 5 mm           | J m m d<br>g l i y<br>f m p<br>u n t b y<br>b h<br>p d m | S t g h t | F l t s e            | F t t<br>d d   | s            | O l | S p t<br>h t<br>b<br>l w f r e p s l f r e d m        |
| 39<br> | ys  | W t r m l<br>seed | B f t 3 d y               | N | 4 mm           | S m h t<br>e   | S t g h t | F l t s e<br>f t m g | F t t<br>c     | 3 s e c      | O l | O b y l i g h t l o c l f m m                         |
| 7<br>  | m   | W t r m l<br>seed | R g h t h p r l l t h n   | N | 4 mm           | N  | S t g h t | F l t                | F t t<br>c r e | m<br>5 s e c | O l | L o c l u z d b h t                                   |
| 4<br>  | 8 m | W t r m l<br>e d  | T h o b h                 | N | mm             | N  | S t g h t | I l t                | F t t<br>c     | m<br>5       | O l | L o c l u z d t h t                                   |
| 63<br> | 4 m | W t r m l<br>l    | R g h t t m b h 3 l y     | N | 5 mm           | N  | S l n d   | F l t                | F t t<br>c     | m<br>6       | O l | L o c l d b h t                                       |
| 37<br> | 8 m | Egg h l l         | L r y 3 l y               | N | L r y g<br>p e | F g l y  | A l l g t | F l t s e            | F t t<br>c     | 9 s e c      | O l | G r f m d t p t t<br>f g m l f f t t                  |
| 9<br>  | yr  | F i s h b n       | L y 9 d y                 | N | L y g<br>p     | F g l y  | A l l t   | F l t                | F t t<br>c     |              | O l | P t h p b l l y<br>t p e p t d l o y<br>t f t h g l t |

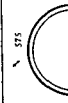
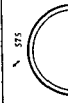
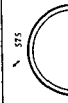
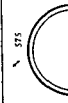
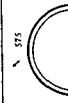
## SEEDS NUTS SHILLS ETC—Continued

| Case \ mbe d<br>III  | Age   | F <sup>gen</sup><br>Body   | Loc                   | h   | T b | F bl m                      | F ps  | F <sup>se</sup> r | R l                          | T m   | R t  | R m l                          |
|--|-------|----------------------------|-----------------------|-----|-----|-----------------------------|-------|-------------------|------------------------------|-------|------|--------------------------------|
| <br>38  | 6 yrs | M 12                       | k h m t h<br>l hus da | N   | mm  | l h m<br>l l<br>-scr        | l l l | l l e             | F re                         | mu    | rad  | R h d l l h<br>l l m l<br>m us |
| <br>83  | yrs   | M 12                       | Tr h t y              | N   | mm  | N                           | ra h  | flat se           | F ur                         | sec   | Oral | D ff se t h<br>se re t         |
| <br>148 | yrs   | M 12                       | Tr h ea, 4 day        | Nom | mm  | l m se<br>m ra ed<br>l p se | ra h  | l l e             | F ra<br>l re                 | m sec | Oral | D ff se t h<br>se re t         |
| <br>188 | 5 yrs | M 12<br>(topp 3<br>m) h ll | Left m b h<br>5 d 5   | N   | mm  | F d                         |       |                   | C had<br>l hro gh<br>hose pe |       | Oral | D ff se t l<br>l re            |
| <br>579 | yrs   | M 12                       | R h l l hus<br>d      | N   | mm  | N                           | t h   | l l l e           | l ra<br>l re                 | m sec | O l  | rad<br>luro h l t<br>h o-      |
| <br>86  |       | M 12<br>sec                | T                     | N   | mm  | se<br>ra ed<br>se           | ra    | l                 |                              | sec   |      | R et<br>se use                 |

|       |   |           |             |                           |   |              |   |         |      |              |           |     |   |
|-------|---|-----------|-------------|---------------------------|---|--------------|---|---------|------|--------------|-----------|-----|---|
| N 4   |   | re        | C ( (pe > ) | F ph g<br>1 m h           | N | mm           | N | St ght  | Fl t | Et t<br>C    | 57        |     | C l t mbedd d<br>l t bel<br>t t loc t d<br>e ph g t |
| N 46  |  | 53rs      | C ( ( > l ) | (F ph g bel<br>4 h 3 h    | N | 7 mm         | N | St ght  | Fl t | Et t         | 5         | O l | N flamm t<br>g t                                    |
| N 3   |  | m         | C ( (pe > ) | T ph g bel<br>7 l 5 g     | N | La 3 g<br>pe | N | All g t | Fl t | F t t<br>C   | 9         | O l | N flamm t<br>g t                                    |
| N 438 |  | 3 >       | C ( ( > l ) | (F ph gu b ) w<br>5 h 5 g | N | 7 mm         | N | St ght  | Fl t | Et t<br>C    | 3 30      | O l | N flamm t<br>g t                                    |
| N 430 |  | 33rs<br>m | C ( ( > l ) | (F ph gu<br>5 h 5 rs      | N | 7 mm         |   | St ght  | Fl t | Et t<br>C re | 3 m<br>53 | O l | C t l t l<br>t d y h w b                            |

## COINS AND OTHER DISKS

| Cat. No. | mt d   | Age   | F. g. Bod.     | Loc.               | A. m. h. | t l                    | t r. m. | T. m. p. | l. m. p. | Res. l. | T. m. | R.  | R. m. Ls.         |
|----------|--|-------|----------------|--------------------|----------|------------------------|---------|----------|----------|---------|-------|-----|-------------------|
| N 48     |   | ys    | li. j. (black) | ph. l. l. ge       | N        | mm<br>~1/2 h<br>occ pe | N       |          | red      | fl. e   | sec   | bul | l. l. m. t. point |
| N 373    |   | 3 yrs | C (1)          | (t. f. ge. day ge) | N        | mm                     | N       |          | red      | fl. e   | sec   | bul | l. l. m. t. point |
| N 8      |   | 7 m   | C (in pen. s)  | ph. m. l. w. d. 3  | N        | mm<br>occ j            | N       |          | red      | fl. e   | sec   | bul | l. l. m. t. point |
| N 6      |   | 3 yrs | C (in pen. s)  | ph. m. l. w. d. 3  | N        | mm<br>occ j            | N       |          | red      | fl. e   | sec   | bul | l. l. m. t. point |
| N        |  | 5 yrs | C (in pen. s)  | ph. m. l. w. d. 3  | N        | mm                     | N       |          | red      | fl. e   | sec   | bul | l. l. m. t. point |

|   |             |           |                                       |   |      |                        |        |      |               |           |      |   |
|---|-------------|-----------|---------------------------------------|---|------|------------------------|--------|------|---------------|-----------|------|---|
| N 575<br> | 33          | C ( k l ) | (E ph gu bel w<br>ph ry g<br>9 d )    | N | 7 mm | N                      | St ght | Fl t | F t t<br>C re | m<br>3 ec | O l  | Fmb if l b l w f l d f<br>ce ph g e d loc l<br>ph g e d loc l<br>ph g e d loc l |
| N 585<br> | 8 m         | C ( k l ) | (Eoph gu bel w<br>ph ry g<br>5 d )    | N | 7 mm | Ob<br>food<br>g<br>d t | St ght | Fl t | E t t<br>C    | m<br>7 f  | Oral | F l food loc l d esoph<br>g g d t b g<br>g g d t b g                            |
| N 60<br>  | m           | C (pe y)  | (E ph gu bel w<br>ph ry g<br>5 k<br>5 | N | 7 mm | N                      | St ght | Fl t | E t t<br>C    |           | O l  | F l l ph g esoph<br>g t d t ce ph<br>g ce py b f d m<br>m l h rpe<br>f y        |
| N 603<br> | 3 rs        | C (pe y)  | (Eoph gu bel w<br>ph ry g<br>4 d )    | N | 7 mm | N                      | St ght | Fl t | E t t<br>C    | 44 ec     | O l  | Slight g t  |
| N 606<br> | 3 rs<br>9 m | C ( k l ) | (E ph gu bel w<br>ph ry g<br>6 d )    | N | 7 mm | N                      | St ght | Fl t | F t t<br>C    | 3 ec      | O l  | OE ph g l m p<br>p tly m t  |











## BUTIONS

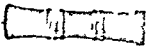


| Number | Age | Free body | Loc              | As | Size | Color | Shape | Texture | Weight | Volume | Material | Remarks  |
|--------|-----|-----------|------------------|----|------|-------|-------|---------|--------|--------|----------|--|
| 567    | 57  |           | ph gu t l<br>h r | N  | mm   |       |       | Free    | sec    |        |          | h h m l<br>f b l m l<br>l l l l l l<br>sec p l f re dm |
| 568    | 58  |           |                  | N  | mm   |       |       | Free    | sec    |        |          |  |
| 569    | 59  |           | Loc f l l<br>b h | N  | mm   |       |       | Free    | sec    |        |          | P m l l l l l l<br>P l l l l l l l                     |

## MINLRAYS

| Number | Age | Free body | Loc              | As | Size | Color | Shape | Texture | Weight | Volume | Material | Remarks                            |
|--------|-----|-----------|------------------|----|------|-------|-------|---------|--------|--------|----------|------------------------------------|
| 600    | 60  |           | Loc f l l<br>b h | N  | mm   |       |       | Free    | sec    |        |          | P m l l l l l l<br>P l l l l l l l |
| 601    | 61  |           |                  | N  | mm   |       |       | Free    | sec    |        |          |                                    |
| 602    | 62  |           |                  | N  | mm   |       |       | Free    | sec    |        |          |                                    |



## DENTAL AND SURGICAL OBJECTS

| Number | Age | Free body | Loc              | As | Size | Color | Shape | Texture | Weight | Volume | Material | Remarks |
|--------|-----|-----------|------------------|----|------|-------|-------|---------|--------|--------|----------|---------|
| 623    | 63  |           | Loc f l l<br>b h | N  | mm   |       |       | Free    | sec    |        |          |         |
| 624    | 64  |           |                  | N  | mm   |       |       | Free    | sec    |        |          |         |

|   |    |                 |                              |      |                           |                |                               |              |                        |  |  |
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| <div>558</div> <div></div> <div>558</div> <div>F E 3</div> | 35 | J l<br>( t )    | 1 4/8 m bel w<br>l r g m l h | 7 mm | B d<br>g l t s            | S g l t<br>l t | E p e l d                     | P l b<br>l o | 5 m                    | I ect m<br>d by  | <div>T h p t t f m m p o d<br/>d p l h e p h<br/>f l l f l t<br/>m l l t s d l l p t<br/>d t a p m p d<br/>f t a p h e p y<br/>J l (F g 3 P l t H)</div> |
| <div>578</div> <div></div> <div>578</div> <div>F E 3</div> | 35 | P l h H<br>u    | 1 1/8 m t b<br>l u l g       | 7 mm | B d<br>g l t l l<br>f l l | S g h t        | P l t                         | F t t<br>C   | O l<br>( d<br>s o r h) | <div>L l l h a e p h<br/>Z l l t l l f l t<br/>f l e b o l y c d<br/>l k t m m t y<br/>l (F g 6 P l t H)</div> |  |



## RUBBER

|  |      |                   |                            |   |     |   |        |      |          |   |     |         |  |
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|  <p>N 6<br/>Fig 34</p>  | 363m | R blue            | Right h<br>7m th           |   |     |   |        |      |          |   |     |         | <p>k libe rem ed p t<br/>m i m p t t m<br/>b d l d mitted<br/>g t p y both l f<br/>d t l and filled th<br/>m l pl b (f g<br/>l l II)</p> |
|  <p>N 69<br/>Fig 35</p> | 6m   | I bl<br>s t p t d | d l t g (m l l l)<br>th d) | N | 7mm | N | St ght | Fl t | T t<br>C | y | O l | of ph t |  |



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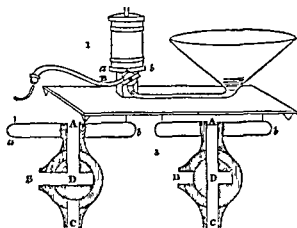


Fig. 1. Transfusion apparatus (taken from Blundell)

having employed the syringe method previous to this Blundell exposed the femoral artery and vein of a dog and introduced a pipe into each. The blood was allowed to flow from the artery into the cup and was then re injected into the vein by means of a syringe. This was continued for a period of twenty four hours about twelve pints of blood in all being re injected. The dog lived. Later he transfused women suffering from loss of blood due to childbirth employing human blood and it is recorded that three out of seven attempts were successful.

In 1835 Bischoff introduced the idea of injecting defibrinated blood and this method became popular with a large group of workers among whom were included Revost Panum Dieffenbach and Brown Sequard. While it was pointed out by Koehler in 1877 that this form of transfusion was fraught with danger owing to the excess of fibrin ferment injected and its use was discouraged by Landois Gesellius Lohbeck and others it was used throughout the nineteenth century although with somewhat abated enthusiasm and in

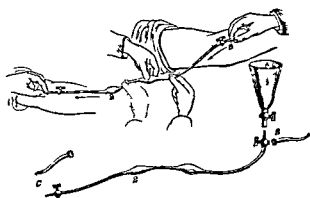


Fig. 2. Transfusion apparatus (taken from Fyler)

fact was quite extensively employed during the first decade of this century until it was replaced by the simple methods of today. During this period other methods were devised. Higginson and Aveling used two cannulas attached by tubing to a bulb syringe. Gesellius and Leisrunk in 1872 employed a glass cannula and Landois in 1875 transfused directly from vein to vein employing cannulas and tubing. Phosphate of soda (Braxton Hicks) and minute quantities of ammonia (Richardson) were advocated as anticoagulants.

Transfusion became an established procedure in the latter part of the nineteenth century and was practiced with a considerable degree of frequency. The success attending the operation was at times brilliant but reactions described as oppressed breathing, choking and a train of other more or less serious symptoms met during transfusion were likely to be attributed to the accidental entrance of air into the vein although as early as 1818 Blundell showed experimentally

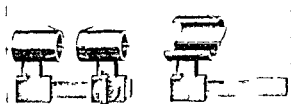


Fig. 3. The simplest form of the instrument (taken from Sorel)

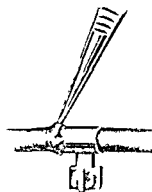


Fig. 4. Showing the blood vessel cuffed by the little bell and against the little bell (taken from Sorel)

BLOOD TRANSFUSION<sup>1</sup>

B. J. F. J. LAMBERTON M.D. F. CHE. T. R. MEXICO  
F. M. H. M. Y. C.

THE history of the development of the operation for the transfusion of blood is an interesting record of alternate triumph and failure. History is replete with evidence that from early time man's imagination has been stirred by the possibility of restoring health, vigor, and even youth to the aged and infirm by replacing blood of the young and healthy. Stimulated by the wonderful possibilities thereof there has been no dearth of investigators, but innumerable difficulties prevented the operation from being applied upon a practical basis until recent years. As expressed by an early English writer, "Transfusion is a sort of Will-o'-the-wisp of science holding out the most brilliant prospect which never seem to be realized."

In the medical literature on the subject are many references to the report that in an attempt to give the life of Pope Innocent VIII in 1491 he was transfused by a Jewish physician. No description of the method employed is given but it is recorded that blood from the Pope was first allowed to run into the vein of a youth whose blood was transferred into the vein of the old man. The lives of three youths were sacrificed in this manner without benefit to the Pope. This is flatly denied in A. H. Matthew, *The and Times of Rodrigo Borgi*. In speaking of the Pope's death he says: "It is related that during his last illness the operation for transfusion of blood was unsuccessfully performed. This however is an error arising from two important facts: first that the idea of this operation could not occur to any one to whom the circulation of the blood was unknown and second that the phenomenon of the circulation of the blood was not discovered until the seventeenth century. Ippolito and Infessura say that a certain Jewish physician undertook to restore the Pope's health. For this purpose he drew all the blood out of three young boys who immediately died. With their blood he prepared a draught which

failed to improve the sick pontiff's condition. The saving virtue of drinking human blood was no new idea."

In 1616 in lectures at the College of Physicians William Harvey first presented a detailed exposition of his views concerning the circulation of the blood but it was not until 1628 that he gave his views to the world at large in his celebrated treatise on *Motion of the Heart and Blood*.

Mentions are made of transfusions performed by an Italian physician Francesco Folli in 1634 and by Daniel of Leipsig in 1664 but in the writings of most recorder the names of Richard Lower of England and Jean Denis of France stand out conspicuously as pioneer the former as the first to practice blood transfusion experimentally and the latter the first to perform transfusion in man.

Lower began his experimental work in 1663 transfusing success fully by anastomosis by means of a cannula or pipe the artery of one animal into the vein of another. In 1667 Denis successfully transfused a man with the blood of a lamb. About the same time King in England, Immerets in France and Kiva and Manfredi in Italy practiced transfusion from animal to animal and from man to man.

It is evident that the new procedure was warmly received by the profession and was put into practice. Death resulted and the operation was condemned in France by the Supreme Court interdicting its practice until the Faculty of Paris should give it approval. This was not obtained and for more than a century the practice of blood transfusion was for aken.

In England in 1815 the experiments Blundell revived the interest of the profession. He devised an apparatus consisting of a syringe connected by a two way stop cock to a receptacle and to a tube in turn connected with a cannula for insertion into the vein of the recipient (Fig 1). He credits Goodridge

<sup>1</sup>The term blood transfusion is used by J. P. S. 11 1616m f h q f h d s f M

of the technique in use at that time and because also of the varied results achieved owing doubtless to the want of the proper understanding of iso agglutination and iso hæmolytic saline infusion was quickly adopted as a substitute. Prior to this in 1850 Hodder in Canada reported cases of cholera treated successfully by the intravenous injection of fresh cow's milk and Brinton lecturer at the Jefferson Medical College in 1878 basing his opinion on the reports of Hodder Thomas and others advocated the injection of milk in place of blood transfusion. He concluded that it was feasible and safe that it was easier than blood transfusion that it was commonly followed by chills that the dosage should not be over 8 ounces and that its practice should not be limited to cases prostrated from the loss of blood but should be employed in disorders which greatly deprecate the blood as in cholera pernicious anæmia typhoid fever and others.

While the operation made rapid advances during the nineteenth century there were two important factors which greatly impeded its progress that is the tendency for the rapid clotting of blood during its transference from the donor to the recipient and the occurrence of hæmolytic resulting from the employment of incompatible bloods. To overcome the first of these ingenious apparatus for the rapid transference of the blood were devised defibrinated blood was employed and attempts were made to delay the coagulation by the addition of chemicals. These were only partially successful. During this time knowledge of iso agglutination and iso hæmolytic was lacking although its clinical occurrence was seen often and repeatedly described in reports but the symptoms resulting were attributed to the introduction of air into the veins.

Early after the advent of the present century rapid progress was made in meeting and overcoming the two chief dangers associated with blood transfusion. Landsteiner and Shattuck independently reported the presence of iso-agglutinins and Landsteiner in 1901 divided human beings into three groups according to the agglutinating reactions of their bloods. In 1907 Jansky proved that

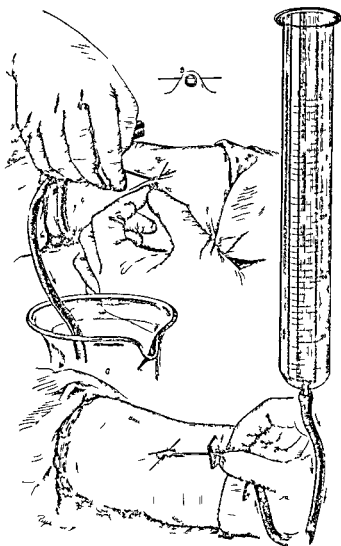


Fig 6 A Cross section of vein transfixed in its upper segment to skin by a straight intestinal needle B Introducing Kaliska cannula into the cephalic vein of the donor. The vein is steadied and prevented from rolling from under the cannula by means of slight traction exerted upon the transfuser needle C Cannula introduced in vein of recipient

human beings fall into four groups and this was later confirmed by Moss who made the important observation that hæmolytic of the red blood cells never occurs without their previous agglutination. The tests for the group determination were simplified by Brem Sanford and others.

Great strides in blood vessel surgery were being made at this time notably by the work of Murphy in 1897 Doerfler in 1899 Carrel and Guthrie Crile and others and this lent impetus to the development of more certain methods of transferring blood.

The first permanent suture of blood vessels

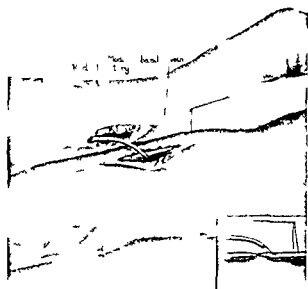


FIG. 1. A. H. T. I. R.

that the admission into the vein of a small amount of air did not produce any serious effect on the animal. One showed that a large quantity of air allowed to enter the vein resulted in death but minute quantities might accidentally get into the vein produced no ill effect. This was also observed by Leven in 1871. In the light of our present knowledge it is certain that many of the reactions were the result of an impure blood.

Fischer and Martin of Berlin in 1850 published a report of 54 cases in which transfusion was done in a hospital practice. There were successful results in 45. Blaud in 1865 collected all the cases for forty years previous and recorded 116 of which were successful. It is interesting to note that 14 of the cases in which undehydrated blood was used all proved unsuccessful. In the many clinical indications for transfusion were then recognized similar to those which are observed today. Letrink in 1871-75. Transfusion is indicated in all the pathological conditions where the blood in quantity and quality is so altered that it is unfit to fulfill its physiological duties. Fryer who apparently was among the first in this country to employ transfusion and who used a modified Aveling apparatus consisting of tube, bulb and cannulas recom-

mended its use in asthenic patients before and after necessary surgical measures in order to avert pyemia and its allied evils especially in operation in which the peritoneum is involved (Fig. 1). Dumas and Prevost and Landi pointed out the injurious effects of transfusing the bloods of dissimilar species. Bruntton Hunter and Celsus in 1870 to 1873 advocated its use in case of monoxid poisoning and reported successfully treated cases. Judging from the frequent warning against its use in bleeding cases except after the bleeding point had been checked it is evident that its haemostatic effect was not recognized.

Buchner in 1869 reports a case of a young woman almost exsanguinated from bleeding from the vagina and bladder following convalescence from typhus who was transfused with three ounces of blood from her husband by letting the blood run into a warmer receptacle and then injecting it with a syringe into the recipient which resulted in cessation of the bleeding. Smith in 1873 reported the case of a child aged 8 years with purpura who had bled from the nose and practically exsanguinated and was then transfused by means of a syringe and cannula dehydrated blood being employed. The result was excellent. No mention was made of the idea of hemolysis and it is apparent that the transfusion was employed solely with the view of replacing lost blood. Its value in filling hemorrhages was early appreciated. Hick attributed its want of success in the case of the postponement of operation until too late. He recognized that patient who had suddenly lost a large amount of blood were likely to repartition those who exsanguination had been protracted.

Autotransfusion by the application of Esmarch bandage to the extremities was advocated by Leier in 1875.

In 1875 with the introduction of normal saline solution for intravenous therapy the argument followed a period of about thirty years in which there was a very noticeable decline in the enthusiasm for and employment of blood transfusion. Because of the technical difficulties met in the successful employment

of the technique in use at that time and because also of the varied results achieved owing doubtless to the want of the proper understanding of iso agglutination and iso hemolysis saline infusion was quickly adopted as a substitute. Prior to this in 1850 Hodder in Canada reported cases of cholera treated successfully by the intravenous injection of fresh cow's milk and Brinton lecturer at the Jefferson Medical College in 1878 basing his opinion on the reports of Hodder Thomas and others advocated the injection of milk in place of blood transfusion. He concluded that it was feasible and safe that it was easier than blood transfusion that it was commonly followed by chills that the dosage should not be over 8 ounces and that its practice should not be limited to cases prostrated from the loss of blood but should be employed in disorders which greatly deprecate the blood as in cholera pernicious anemia typhoid fever and others.

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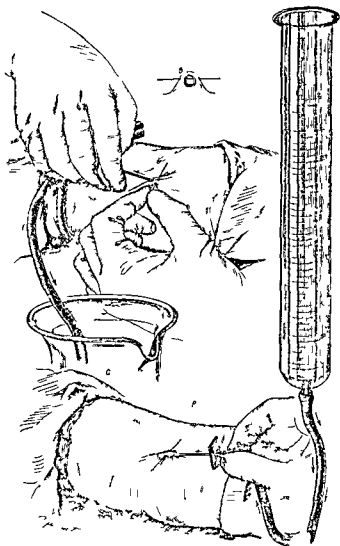


Fig 6 1 Cross section of vein transfused in its upper segment to skin by a straight intestinal needle. B Introducing Kalish's cannula into the cephalic vein of the donor. The vein is steadied and prevented from rolling from under the cannula by means of slight traction exerted upon the transfusing needle. C Cannula introduced in vein of recipient.

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The first permanent suture of blood vessels

was made by Eck a Russian in 1879 when he established a lateral anastomosis between the portal vein and the inferior vena cava. Murphy in 1897 successfully anastomosed in men the divided femoral artery by invaginating the proximal into the distal end. Carrel and Guthrie by the most painstaking details perfected blood vessel suture. While Nitze in 1897 and Payr in 1900 made successful vessel anastomoses by means of ivory clamps and magnesium rings respectively it remained for Crile the real pioneer in modern blood transfusion to perfect a method of anastomosing vessels intima to intima by the employment of a cleverly devised cannula. He put the method in practice experimentally and in clinical research reporting 25 experimental and 3 clinical transfusions at first anastomosing artery to vein later showing that transfusion could be successfully and readily accomplished by vein to vein anastomosis.

Stimulated by this work the profession began to realize more clearly than ever the really enormous therapeutic value offered by blood transfusion and there followed in rapid succession the publication of numerous articles describing new and simple methods for transferring blood and advocating wider fields of application. In 1909 Brewer and Leggett after successfully experimenting on 31 animals advocated transfusion by the interpolation between the artery and vein of a paraffin coated glass tube. In the same year Frank and Baehr transfused by means of a vascular bridge or link made of a dog's carotid and preserved in 2 per cent formalin to connect the artery to the vein. The Lespinasse and other modifications followed.

Ingenuous modifications of the Crile cannula were devised by Buerger, Sorens, Jancway, McCrath and others (Figs. 3 and 4).

Hull has described a method of arteriovenous anastomosis which for its simplicity and sureness of accomplishment should commend itself to those who may have occasion to perform an emergency transfusion when anti-coagulants and the ordinary apparatus are not to be obtained. The donor's radial artery is exposed and divided and compression is made on its proximal end to prevent flowing. The recipient's vein is exposed

for a distance of one inch and a small slit is made in it large enough to admit the artery which is carried into it by means of a needle and suture (Fig. 5). Mann has reported its successful application in experiment<sup>6</sup> with the method in the laboratory.

The use of any of these methods necessitated the sacrifice by the donor of either an artery or a vein and with every donation he subjected himself to considerable risk. In addition it was impossible accurately to determine the amount of blood transfused estimates being based upon blood pressure and hemoglobin readings. Curtis and David overcame the last objection by employing a receptacle for the blood and then re-injecting. Their apparatus consisted of a glass bulb paraffin coated with two cannulae tip at one end and attached to the other end by means of rubber tubing and a syringe. This idea was modified by Kimpton and Brown, Percy and Satterlee and Hooker and it resulted in the perfection of a method of transfusion which under favorable circumstances is ideal. The one essential objection lies in the difficulty in the coating of the tube and connections with a uniform layer of paraffin. Any error in this means failure.

In 1891 von Ziemssen devised and employed successfully a method of transfusion by means of syringes and cannulae. By rapid work he was able to draw 20 cubic centimeters of blood from a subcutaneous venous puncture disconnect the syringe and empty it through a needle similarly placed in the recipient's vein before coagulation took place. By filling the syringes one after another he transfused 80 cubic centimeters at one time. The method did not receive the attention it deserved and was soon forgotten. In 1913 Lindemann improved the technique by adding a larger number of syringes which were kept constantly washed by an assistant and by devising a special nest of three cannulae the outer one rounded on its end to prevent injury to the intima. Its application was certain and with a specially trained operator and assistants the method was nearly perfect. By the utilization of the principle of a two way stop cock modifications were devised by Freund, Ungar and Kush.

In 1914 Hartwell wrote "The attainment of the ideal seems to lie in the development of a method by which coagulation and other alterations of the blood are prevented during the time required to draw sufficient blood (1000 cubic centimeters) into a receptacle connected by subcutaneous venous puncture with the donor and to empty it again through a similar puncture in the recipient—these two principles if desirable being in separate rooms. Except in the hands of those skilled in the application of a special technique and under the most favorable circumstances, none of the methods up to this time fulfilled all of these requirements. Excluding those methods in which the technique required the employment of a paraffin coated receptacle the successful application of all others was dependent upon the rapid transference of blood from donor to recipient in less than the normal coagulation time. In devising a technique to fulfil the requirements of the ideal it was natural then that means should be sought to retard the coagulation time without altering the normal properties of the blood. Various means were employed that is by the dilution of the blood with normal saline by isotonic glucose and by the addition of chemicals namely herudin and sodium citrate.

In 1914 and 1915 Hustin Agote Weil Lewisohn Rueck and others working independently of one another published articles recording experiments and clinical application of transfusions performed with citrated blood. Hustin's article appeared August 6 1914. He mixed the blood with equal parts of isotonic (5 per cent) glucose solution to which was added 20 cubic centimeters of sodium citrate for every 200 cubic centimeters of blood glucose mixture. He claimed that citrate of soda impaired the oxygenating property of the blood and the addition of glucose was necessary to overcome this. He reported experiments and one clinical application in man. The first transfusion performed in man by blood rendered incoagulable by the addition of sodium citrate alone was performed by Prof. L. Agote of Buenos Aires on November 14 1914. He employed 1 gram of neutral sodium citrate in 5 per cent solution for every

100 cubic centimeters of blood. Weil observed that citrated blood augmented the coagulative properties of the recipient's blood. From the work of Lewisohn in determining the proper dosage of sodium citrate which can be used with safety there has developed a method which unites four advantages in surgery of extreme importance—facility rapidity efficacy and security and which fulfills in every detail the requirements of the ideal.

#### CLINICAL APPLICATION

This report of a series of 1036 blood transfusions summarizing the results and recording the general indications and dangers is submitted because of the belief that the most accurate test of the value of any therapeutic procedure developed from experimental study lies in its repeated clinical application.

The 1036 transfusions were performed on 429 patients between January 1 1915 and January 1 1918 in the Mayo clinic. Five were done by means of the paraffin lined cylinder 30 by a modified cannula syringe technique and the others 1001 by the citrate method.

#### INDICATIONS FOR TRANSFUSION

With the development of simpler methods of technique and with the introduction of accurate blood tests blood transfusion has lost the dangers which once attended its use. Until today it is a safe and proved therapeutic measure rather than merely a means of last resort. If blood transfusion is looked upon as a homologous transplantation of living tissue as suggested by Hartwell the indications may be epitomized as being those which indicate the necessity of restoring the lost or impaired body tissue (blood) by a homologous transplant. Definite effects of transfused blood are: (1) restoration of the bulk of the circulating fluid (2) provision of oxygen and assimilable pabulum for tissues (3) increase of the coagulability (4) stimulation of the hematopoietic organs and (5) increase of resistance to infection by its antitoxic and bactericidal properties.

In this series the case may be grouped according to indications for transfusion as follows:



1 Primary (pernicious) anæmia 657 transfusions in 183 cases

2 Secondary anæmia 243 transfusions in 149 cases

|                    |          |
|--------------------|----------|
| Chronic infection  | 24 cases |
| Malignancy         | 44 cases |
| Chronic hæmorrhage | 43 cases |
| Acute hæmorrhages  | 7 cases  |
| Hæmolytic jaundice | 4 cases  |
| Splenic anæmia     | 0 cases  |
| Actinomycosis      | cases    |
| Cause unknown      | 15 cases |

3 Bleeding 81 transfusions in 59 cases

4 Acute toxic and septic conditions 34 transfusions in 25 cases

5 Leukæmias 20 transfusions in 10 cases

6 Shock 1 transfusion in 1 case

A detailed analysis will not be made of the cases included in this report but for completeness a general summary and discussion of the results obtained will be given under each group of cases.

*Group 1 Pernicious anæmia* Basing his opinion presumably upon the fact that destruction of the patient's own blood is more or less continuous in this group of cases, Soresby classified pernicious anæmia with malignancy as being the two diseases in which the operation for blood transfusion was absolutely contraindicated. While the percentage of occurrence of the milder reactions following transfusion is decidedly greater in this class of cases due probably to the slight hæmolytic action of the blood of the patient upon the blood transfused, definite beneficial effects are seen in a very large percentage of cases. The result varies in different patients and also in the same patient following separate transfusions. Whether this variation is the result of the difference in the stimulating properties of the bloods of the different donors or to a difference of degree in the active hæmolysis of the patient depending upon the stage of the disease is a matter of conjecture. The observation based upon the results in this series would tend to support the latter theory. One patient who had been transfused previously with definite improvement returned after several months in a very grave condition—lethargy, temperature 103, hæmoglobin below 20 and red blood cells below one million. He was given 500 cubic centimeters

of blood from a suitable donor. A definite reaction of chill fever increased drowsiness and hæmoglobinuria followed and later herpes on the lip. The patient received no improvement from the transfusion.

A series of transfusions ranging from 1 to 30 was practiced in the cases in this group some were performed preceding and following splenectomy but the vast proportion were in non-operated cases. The results were equally good in the different groups. One case of unusual interest is herein reported.

A male aged 36 years, admitted for examination February 10, 1915, with a history of good health until about one year previous to admission when weakness, shortness of breath and increasing pallor gradually developed. From the history, examination and blood findings a diagnosis of pernicious anæmia was made. At this time his hæmoglobin was 0 per cent, red blood cells 1,730,000 with the presence of no morphological megaloblasts. Splenectomy as performed March 10, 1915 and April 1915 before his dismissal the hæmoglobin 0 and the red cells 3,640,000. Following acute tonsillitis in the fall he began to run down and on December 1, 1915 he returned with hæmoglobin 0 and red blood cells 1,100,000. From then until May 1918 he had thirty-five transfusions of 50 to 750 cubic centimeters each. His response to the transfusions has been remarkable. Ordinarily to four transfusions at weekly intervals are required to effect a definite remission in the case of the disease. His condition now is apparently as good as it was two years previously. It is of peculiar interest to note that the blood of the patient belongs to Group 1 and while the hæmoglobin has been transfused into him blood of all four groups with any evidence of hæmolysis he has retained his original group.

The conclusions of Archibald, who made an extensive study of a part of the cases in this series, hold good for the series in its entirety. In effect his conclusions were that the greater number of the patients except those who have reached the very last stages of the disease will receive immediate benefit from the transfusion of blood. Many also who are in extremis and who are not benefited by medical treatment alone will show great improvement by a series of blood transfusions.

*Group 2 Secondary anæmias* Except in the seven instances in which the anæmia was due to acute hæmorrhage the majority of the patients in this group were transfused preliminary to operation with the idea of improving their general condition and thereby

increasing their resistance to infection. In cases of acute frank and concealed hæmorrhages the enormous value of replacing the lost bulk of fluid by blood in connection with efficient surgical means of checking further loss is well recognized. As pointed out by Hicks in 1869, the want of success in transfusion lies in the postponement of the operation until too late a period. The normal quantity of blood is estimated to be one twelfth to one fourteenth of the body weight and clinically the rapid loss of one half of this amount proves fatal. Various rules of thumb have been offered based upon the blood pressure readings and hæmatologic estimates indicating when to transfuse and when it is safe to wait. Dorrance considers it imperative to transfuse when the count falls to 1 000 000 red blood cells and 20 per cent hæmoglobin or below and optional when the red cells are 1 500 000 and hæmoglobin 30 per cent. DePage studied wounded soldiers and found that when the red cells fall below 4 500 000 in three hours 4 000 000 in eight hours or 3 500 000 in the first twelve hours the patient will probably die unless transfused. Others have considered the blood pressure readings as the most reliable indicator pointing out that systolic pressure below 80 mm Hg meant danger. Hicks relied solely upon clinical symptoms especially the obstinate jactitations and resistance to comply with our wishes in regard to treatment coupled with the persistent indistinctness of pulse. Robertson warns us against using ordinary resuscitative measures before resorting to transfusion. Our clinical observations bear out his belief that permanent degenerative changes occur in the organism when the exsanguinated condition persists for more than a few hours. We advise transfusion when in doubt. From experiments Rous and Wilson demonstrated that the amount of hæmoglobin retained in the severest hæmorrhage is above the point necessary to sustain life. Unless the blood withdrawal is too rapid the organism replaces this bulk by substituting plasma which the body retains in reserve and thus maintains blood pressure. In animals bled the investigators were able to raise and maintain the blood pressure reading by the

injection of either horse serum or gum acacia (7 per cent). The effect of normal saline solution was only transient as this quickly leaves the vessels for tissues and urine. David and Curtis showed that dogs bled under similar conditions until there was cessation of flow at the carotid could be resuscitated either by injection of physiologic serum or by transfusion. However in the eighteen hours following this experiment 77 per cent of the dogs treated with serum died and only 6 per cent of the animals transfused succumbed. In all but two cases in this series of acute hæmorrhage the transfusion was life saving or greatly beneficial. In the two unsuccessful cases the patients were temporarily restored but later died due to the continuation of the bleeding.

The results of transfusion on the weak, starved and uremic patient as a supportive measure preliminary to operation are eminently gratifying as is evidenced both by the increased ability to withstand the operation and by the rapid postoperative convalescence. In the anæmic cases in which the patients are to be submitted to abdominal operation transfusion is especially indicated. It may be safely asserted that in practically all operations in which the gastro intestinal tract is opened there is more or less soiling of the peritoneum which potentially spells peritonitis. It is the normal resistive elements of the organism which prevent this eventuality or limit it to a small area. In those cases in which the resistance of the body has been impaired by chronic bleeding, malignancy and chronic infection this complication is most frequently seen. The value then of transfusion as a preliminary measure is illimitable.

*Group 3. Bleeding.* The general oozing which follows certain operations especially in intensely jaundiced patients has always been a source of grave concern to the operator who in most instances has been without efficient means of checking it. The results of blood transfusion in these cases have been strikingly good usually the hæmorrhage ceases almost immediately and the patient's improvement is quickly obvious. In certain cases usually of the malignant type in which

the biliary obstruction has not been relieved by the operation the hæmostatic value of the transfusion rapidly decreases after 48 to 72 hours and the patient may start bleeding again. Also in the oozing occurring after operations on the stomach and intestines transfusion alone will often be followed by complete and permanent cessation of bleeding and the rapid convalescence of the patient. The bleeding in ulcers of the stomach and duodenum is usually due to an erosion of one of the larger vessels and transfusion should always be considered preliminary to or in association with a laparotomy for the excision of the ulcer. For the postoperative bleeding in patients suffering from blood dyscrasia transfusion is an effective hæmostasis but probably has no effect upon the ultimate course of the disease. It is of interest that clinically the use of an anti-coagulant in the transfused blood not only does not retard the coagulability of the recipient but possesses an equal power of hæmostasis with the undiluted blood administered by the syringe cannula method. Experimentally this observation was borne out in a series of 41 transfusions by the citrate method in which the coagulation time of the recipient was tested by means of a Boggs' coagulometer and by Lee's test tube method just prior to and immediately following the transfusion. In 25 instances (58 per cent) the coagulation times was lowered from 1 to 6 minutes in 6 (14 per cent) it was not affected and in 1 (8 per cent) it was increased from 1 to 3 minutes. The coagulation time of a hæmophilic not included in this series of tests was taken before transfusion and recorded as 23 minutes. Five minutes after the transfusion of 500 cubic centimeters of citrated blood the coagulation time was 3 minutes 1 hour later it was 8 minutes and on the fourth day after the transfusion the coagulation had returned to 0.

#### *Group 4 In toxic and septic conditions*

The cases included in this group were for the most part infections following abdominal operation and while the results are not encouraging largely because of the fact that the patients were hopelessly ill before transfusion was employed we believe that if

given shortly after or in some instances before the operation blood transfusion offers a reasonable means of combating infection.

*Group 5 Leukæmias* As a temporary supportive measure for the correction of the anemia the results in the ten cases in this series justify the employment of transfusion.

*Group 6 Shock* In this series the diagnosis of surgical shock has been made in the cases of postoperative patients in whom there is no tenable etiologic factor for the production of the chain of symptoms usually attributed to this condition. The clinical diagnosis is often disproved upon re opening the abdomen or at necropsy by the presence of concealed hæmorrhage or fat embolism. In the one case in this series transfusion was without beneficial effect.

#### METHOD OF TRANSFUSION

Since December 1915 we have employed the citrate method exclusively and it has been used in this series of cases in 1001 instances. According to Howell the role of calcium in the phenomenon of coagulation is to activate prothrombin into the formation of thrombin (fibrin ferment) which in turn activates fibrinogen into fibrin. By the addition of citrate of soda coagulation is prevented by the chemical immobilization or stabilization of the calcium without forming precipitate. Excessive intravenous injection of citrate of soda deprives the blood and tissues of calcium and the symptoms of convulsions, tonic and clonic tetany, paralysis and dyspnoea are the results of the decalcification of the nervous system. To combat this H. Don would administer calcium in the proportion of one atom to three molecules of the trisodic citrate. Lewisohn experimenting with a 10 per cent solution found the toxic dose equivalent to 0.3 grams per kilo and later Carter showed that the more concentrated the dosage the smaller the lethal dose. He found the lethal dose with a 1 per cent solution to be 0.835 to 1.4 grams per kilo. Early in this series it was observed that there was a tendency for the milder reactions to occur in cycles which corresponded in a striking manner with the preparation of fresh citrate solution. It was observed that citrate in

solution rapidly deteriorates and the importance of employing freshly prepared solution was thus emphasized. From the recognition of the fact that the coagulative properties of different bloods vary in different persons as evidenced by the occasional coagulation of blood withdrawn from the donor in a 2 per cent citrate solution we have substituted a 0.4 per cent citrate solution.

#### TECHNIQUE

The arm of the donor is prepared in the usual manner. A tourniquet is lightly applied above the elbow and the median basilic or the median cephalic vein is either punctured with a large sized needle or exposed by a small incision and a cannula introduced. By a simple yet very ingenious little trick advised by Watson we have been aided greatly in introducing a large sized Kaliski (gauge 11) needle into the lumen of the vein. By means of a small straight intestinal needle inserted transversely the vein is transfixed to the skin the needle passing through its upper segment. With the end of this transfixing needle as a handle the vein is steadied and the cannula needle directed parallel with the line of the vein can be readily pushed beneath the level of the transfixing needle into the lumen of the vein (Fig. 6). The blood is received in a sterile graduated glass jar containing 30 cubic centimeters of a per cent sterile solution of sodium citrate at the bottom. While the blood is running it is well mixed with the citrate solution by means of a glass rod. The flow of the blood should be in a steady continuous stream and when there occurs slowing of the stream as is often observed with a sudden drop in venous pressure due either to syncope or the too snugly applied tourniquet the needle should be immediately withdrawn and a clean one inserted. If the blood is allowed to flow in an unimpeded stream there will be clotting of the whole or part of the blood collected because of the incipient coagulative changes which have taken place in transit from the vessel to the citrate solution. After the blood has reached the 250 cubic centimeter mark another 30 cubic centimeters of the citrate solution is added and the blood is

permitted to flow until there are 500 cubic centimeters of the mixture. If more blood is desired a sufficient amount of citrate solution is added to maintain this ratio of 0.24 per cent. The blood may be carried to the recipient's room or the recipient may be brought into the operating room. The needle is then introduced into the recipient's vein after the manner above described and attached by rubber tubing to a glass irrigating flask the tubing and the bottom of the flask having been previously filled with saline solution. The citrated blood is then transferred into the flask and permitted to flow into the vein of the recipient. It is advisable to have the blood run in slowly in order to guard against suddenly overloading the right side of the heart and in order to watch for any untoward effects upon the patient. A marked slowing of the pulse syncopal attacks dyspnoea cyanosis a sensation of cardiac oppression or excruciating pain throughout the body especially localized in the small of the back should be interpreted as danger signals and if these persist after temporary stopping of the flow it is advisable to conclude the operation at once and another donor should be secured.

The amount of blood to be transfused should be dependent upon several factors namely the age of the patient the presence of associated physical impairments such as cardiac lesions arteriosclerosis etc. and the pathologic condition for which the transfusion is indicated. Unless for the purpose of replacing a large bulk of blood lost from an acute hemorrhage the impression received from the study of this series of cases would indicate that better results are to be expected from the use of a relatively small quantity 500 to 750 cubic centimeters repeated in from five to seven days rather than from a single transfusion of a larger amount. While the evidence is most conclusive that the transfused blood lives for a time at least as a transplant yet a greater value in many of the anæmic conditions lies in its stimulating effect on the blood forming organs of the recipient as is evidenced by the secondary rise in the hæmoglobin and blood picture which occurs four or five days after the transfusion.

## DONORS

In the selection of a suitable donor a young healthy robust individual is desired. Our results tend to corroborate the observations of Peterson that the value of the transfusion is largely dependent upon the individual donor. One donor's blood may exhibit remarkable powers of hemostasis that of another may induce unusual hematopoietic stimulation and that of another owing to the presence of some antibody may exert real antitoxic effect. The blood of every donor should be tested for syphilis and as to its compatibility in reference to agglutination and hemolysis. The seriousness of transmitting syphilis or other diseases especially to those patients in whom there is no urgency for the transfusion cannot be overestimated. As our ability for detecting syphilis by examination and Wassermann test is within limits and as there is a possibility of the infection of the donor subsequent to his examination the chances of transferring syphilis while admittedly small should always be considered and unless the transfusion is performed in emergency this possibility should always be explained to the patient. Two instances of syphilis transmission are reported in the literature. In our series syphilis was transmitted by transfusion in one instance. This patient had been receiving a series of transfusions the blood of the donor in each instance was Wassermann negative. One man who had served as a donor about twelve days prior to the development of the skin eruption was suspected as the infecting donor but these suspicions could not be definitely confirmed.

Since July 1916 the blood of the prospective donors has been tested according to the Moss agglutination test as modified by Brem. In instances of the newborn when it is necessary to transfuse in order to check hemorrhage Cherry and Langrock have showed in a series of 34 tests that the mother is always a suitable donor. However it should be emphasized that after the first few weeks of life the child develops an independent group of its own which is not necessarily the same as that of the mother and accordingly tests should always be made preliminary to trans-

fusion. In an emergency such as that following an acute hemorrhage when the life of the patient is dependent upon an immediate transfusion it is justifiable to use a donor without a preliminary test. In such instances the operator should allow the first 200 cubic centimeters of blood to run in slowly. If the patient shows symptoms of hemolysis the operation should be concluded or another donor secured. In this series we used donors *without preliminary test in eight emergency transfusions* and in none of the patients was there any evidence of hemolysis. These results we believe were due to good fortune.

In 1913 Ottenberg and Kaliski explained that in the instance in which the serum of the donor is agglutinative to the cells of the patient the plasma of the donor on transfusion will be diluted by the excess of the patient's plasma and will meet with a large excess of agglutinable cells. In practice they had four such transfusions with no unfavorable results. When it has been feasible we have always made it a point to use a donor in the same group as that of the recipient but in a great number of instances as in emergencies and in cases in which a relative or volunteer donor is obtainable whose blood is not in the same group with that of the recipient we have used donors whose cells are not agglutinable by the serum of the patient. In Group 4 there is a large percentage (43 per cent) of persons whose blood is suitable for transfusion with the blood of all the groups and this point has been utilized in our emergency transfusions. Formerly in cases of utmost urgency we were forced to take a large chance by using an untested donor but now there is always on call a list of prospective donors in Group 4 whose blood we have absolute confidence will be suitable with that of any patient. In the entire series there have been no untoward effects upon the donor from the loss of 500 to 750 cubic centimeters. On the other hand the loss of blood in the majority of donors has been followed by a temporary gain in weight. Many of these donors continue their normal duties immediately upon the conclusion of the transfusion. We have used especially robust persons as donors as often as 8 times within 12 months.

There are three well recognized accidents associated with and complicating blood transfusions namely acute dilatation of the heart embolism from the introduction of air or clotted blood and hæmolytic changes. The first two accidents are absolutely preventable by the exercise of due caution as to the technique the rapidity with which the blood is permitted to flow and the limiting of the quantity of blood in cases of suspected cardiac and circulatory impairment. The third danger due to the incompatibility of the blood of the donor and the blood of the recipient is controllable by accurate blood tests. By the term 'hæmolytic' we mean the destruction of the red blood cells with the liberation of the hæmoglobin and clinically we detect this by the finding of hæmoglobinuria increased urobilin in the urine and phagocytosis of red cells. The gravity of the danger depends upon the degree of destruction.

#### REACTIONS

In 19 transfusions (21 per cent) of the series there occurred from 15 minutes to one hour later a slight reaction of chill and fever a temperature of 100 to 105 with or without malaise headache nausea and vomiting and diarrhoea and followed in a small percentage of cases on the third day after the transfusion by an eruption of herpes. In another 15 per cent of transfusions there occurred a rise of temperature to 100 or above not associated with chill and nausea. These were in every instance of a transitory nature the temperature returning to normal in from 1 to 36 hours and in only two instances was it probable that the good of the transfusion was vitiated by this complication.

The nature of such reactions is unknown. Various theories have been suggested for example (1) the introduction of a foreign protein (2) the introduction of a citrate solution (3) incipient coagulative changes in the transfused blood (4) slight degree of hæmolytic changes occurring after transfusion not sufficient to be evidenced by clinical test and (5) incompatibility of the white corpuscles of the donor and recipient. All may be factors but in this series there was a striking relation ship between the pathologic condition for

which the transfusion was indicated and the occurrence of these milder reactions. A decidedly higher disproportion in the percentage was seen in those cases such as pernicious anæmia and advanced malignancy in which there were active hæmolytic changes. In some of these the intravenous introduction of normal saline alone was followed by similar reactions.

In 1915 Bernheim collected data of 800 transfusions performed by 12 different operators and reported the occurrence of hæmolytic in 15 cases with four deaths. In 1 instance in this series there were group reactions. The blood of three of these patients had been tested by the old macroscopic test and the others had been grouped by the method of Brem. In every case in which the blood had been grouped by the microscopic test we were able later to locate an error in the testing. Most of these were due to a clerical error in recording the group of the donor or the recipient. In one patient supposedly in Group A attempts were made on two different occasions to inject blood from a donor in Group A and both times we were forced to stop because of the occurrence on the table of a severe reaction. Later this patient's record was reviewed and he was found to be in Group B instead of Group A. Retesting proved this and subsequent transfusions with Group B donors were unattended by any reaction. These reactions are most typical. They occur early after the introduction of 50 or 100 cubic centimeters of blood the patient first complaining of tingling pains shooting over the body a fullness in the head and an oppressive feeling about the precordium and later an excruciating pain localized in the lumbar region. Slowly but perceptibly the face becomes suffused a dark red to a cyanotic hue respirations become somewhat labored and the pulse rate at first slow sometimes suddenly drops as many as 20 to 30 beats a minute. The patient may lose consciousness for a few minutes. In one half of our cases an urticarial eruption generalized over the body or limited to the face appeared along with these symptoms. Later the pulse may become very rapid and thready the skin becomes cold and clammy and the patient's

condition is indeed grave. In from fifteen minutes to an hour a chill occurs followed by high fever a temperature of 103 to 105 in which the patient may become delirious. *Jaundice* may appear later. The macroscopic appearance of hemoglobinuria is almost constant. In three such instances the symptoms were not recognized at the time of the transfusion and 500 cubic centimeters of blood were injected. All the patients died two in one and three hours respectively following the transfusion and one became comatose shortly afterward and died 30 hours later. In the other 9 instances the symptoms were early recognized and interpreted and the transfusion was concluded after the injection of 50 to 100 cubic centimeters of blood. Adrenalin and atropin were administered with good effect. There was no mortality in this group.

Writers notably Ottenberg and Kahli Bernheim Brem and others for a number of years have been emphasizing the importance of preliminary blood tests and yet today there are a few who advocate such a measure only when it is convenient. The cases in our series point out most strikingly the fact that the injection of incompatible blood namely in which the donor's cells are agglutinable by the serum of the patient is attended by the development of symptoms of the gravest nature and that if these are not early recognized and the transfusion concluded before the injection of a large quantity of blood fatal results are to be expected.

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## THE TREATMENT OF CERTAIN TYPES OF ANORECTAL FISTULA

B ARTHUR A LANDSMAN M D NEW YORK

At d g Rectal S g Phlant p H l A soc S g R tal I partm P G d V d l hool d Ho-p l  
D ty b g D es f b R m O P t D p rtm N w l k H p l

THE successful operative treatment of anorectal fistula has offered difficulties which are nothing short of surprising when we consider the brilliant achievements of the surgery of other regions during the past quarter of a century. The end results have been far from satisfactory, even at the hands of the most expert judges, by the frequency of recurrences, postoperative complications and sequelæ. Every surgeon must recollect instances from his own practice in which radical operation, apparently thorough and complete, has been followed by humiliating failure, despite careful precaution during and after the operation. This is especially true of certain types of non-specific, complex anorectal fistula in which there is still some confusion as to what constitutes ideal treatment. We refer to those which have one or more external openings on the skin, connected with one or more internal openings in the rectal wall, occurring simultaneously in both ischio-rectal fossæ, from either two independent abscesses running their course at the same time, or originating from a single infective focus by extension of the inflammation through the anococcygeal ligament. The proper operative management of such a condition requires skill and experience, for it is in this type of a case one is likely to meet not

only a considerable percentage of recurrences, but distressing complications as well. Given such a problem, the surgeon is confronted with one of two alternatives: to follow up the tracts and cut through the sphincters on both sides at one sitting, or permit one side to heal up first, before doing a secondary operation on the other at some later date. Division of the sphincters in more than one place exposes the patient to the danger of incontinence, especially if both external and internal sphincter muscles have to be divided. While operation in two sittings subjects him to a double risk, and a prolonged convalescence, not to be lightly dismissed in a person already weakened from an exhausting suppurative process.

The writer has tried a plan which seeks to overcome these difficulties. It is based on the observation that under certain conditions a complete anorectal fistula will heal and remain permanently closed, even if its internal opening is left undisturbed. Time and again do we see patients in our dispensary, who have small sinuses which open into the rectal wall, and yet if at the time of operation the surgeon fails to locate such openings, it happens that some of these patients nevertheless are found to be cured permanently when examined months after

wards provided other conditions are favorable. This we believe may be accomplished in a majority of cases by careful attention to certain details which may be set down as being fundamentally concerned in the successful treatment of anorectal fistula. It goes without saying that the principles which apply to the treatment of a fistula (which is nothing more than a chronic abscess cavity contracted down to a thin tubular tract) differ in no wise from those which medical science has found to be true in all other infections; they are constant physical values modified only by local anatomical and physiological conditions. Failure to recognize this basic fact has given us a false conception of the situation, wrongly influenced our methods and led to annoying complications. The key note of the surgical treatment of abscess is prompt radical and thorough drainage to permit the organism to rid itself of as many of its invading enemies as possible, prevent the absorption of their poisons into the blood and stimulate and encourage repair. These conditions find their most favorable expression when the parts are kept at rest, because sick organs and diseased tissues will not repair readily when their natural processes are disturbed by constant changes in the medium which surrounds them. There is no proof that re-infection from wound products and fecal discharges play more than a secondary rôle in the treatment of fistula, provided only that good drainage is available for the evolutionary tendency in an otherwise sound organism is toward repair and recovery and not toward destruction and death when favorable conditions are permitted to assert themselves.

Our plan then is to cut into one of the external openings and connect all of the tracts of one side with each other by suitable incisions, break up all pockets, trim away scar tissue, exuberant granulations and as much of the edges of the wound as appear dead or badly infected, attend to hæmorrhage and convert the wound into one single cavity with walls smooth and clean, then repeat the process on the other side *without however dividing the sphincter on either side*. This procedure provides for the necessary drain-

age. The next step is intended to immobilize the parts by cutting through both sphincter muscles in the posterior median line, regardless of the location of the internal openings. This enables the parts to secure the rest they require to complete their healing and does away with the necessity of the division of the sphincter on each side in two different places. Moreover the posterior incision is in a neutral position in respect to both fistulas and will confer equal benefit to both instead of much benefit to one and but little to the other. It possesses the further advantage of enabling us to drain both ischio-rectal fossæ through a single opening and is less liable to be followed by damage to the fibers of the external sphincter. Because of their anatomical arrangement these can be practically split in this situation instead of being divided transversely. The posterior incision does not injure any vital parts and being in a more dependent position when the patient is in bed enables us to carry out drainage more easily while anteriorly there are important organs in both male and female besides dense fibromuscular structures which meet at the central tendon of the perineum and are necessary to the integrity of the pelvic floor. Their division impairs the strength of the outlet and causes sagging of the supporting muscles, an obvious objection in female patients.

The rest of the treatment is carried out with the same painstaking care which should be the rule in all cases of fistula. We have tried our plan in a limited number of bilateral anorectal and so called horseshoe fistula and would recommend its use in suitable cases.

#### SUMMARY

The indications of successful treatment of of non specific complex anorectal fistula occurring simultaneously on both sides may be met by —

- 1 Adequate drainage obtained by proper operative means
- 2 Complete rest by division of the muscles not necessarily in line with the internal openings

Given these the internal openings may be trusted to take care of themselves.

## A PRACTICAL CLASSIFICATION OF CUTANEOUS NEOPLASMS

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F m h Lab ry US IP th l gy C l mb U rs

A CAREFUL examination of the ponderous forms of classification invented by the dermatologist and the simpler but more subtle arrangements that pure pathologists have evolved leaves one with the feeling that for the useful purpose of clinical diagnosis the broadest and most obvious differentiation of skin tumors would be the most practical. Looking at the subject from this point of view let us consider cutaneous neoplasms in three groups: (1) those upon the skin (2) those in the skin and (3) those beneath the skin.

Of course these broad divisions necessarily include intermediate or borderline zones yet although the integrity of the divisions by no means inviolable the form is so simple and so obvious that I shall attempt to justify its use by the clinician.

1 New growths upon the skin we may define for our purpose as those projecting markedly beyond the surrounding surface plane in which there is visually or palpably evident proliferation of the morphological layer of the integument.

2 New growths in the skin usually project little if at all beyond the surrounding surface plane but are more apparently connected with (or even a part of) the deeper dermal layers as if the proliferation involved the entire thickness of the skin.

3 New growths beneath the skin we must consider as including those cystic or solid tumors which while connected with the skin and often elevating it beyond the surrounding surface plane fail to exhibit any evident proliferation of the epidermis but rather a thinning of the overlying integument.

Papillomata and epitheliomata (especially those of the papillary type) fall readily into the first of the above classes.

Fibromata keloids granulomata pigmented moles angiomata of capillary type the rare composite or fibroepithelial tumors melanocarcinomata and sarcomata (except

such metastases as may at first be entirely beneath the skin) belong in class

Implantation sebaceous and dermoid cysts lipomata of pure or fibrous type and cavernous angiomata are classified with the third division.

During the past eight or nine years morphological diagnoses have been recorded in the Department of Surgical Pathology on a few more than 350 new growths of the skin which may be grouped according to our proposed classification as follows:

## 1 Tumors upon the skin

|               |                |           |
|---------------|----------------|-----------|
| Papilloma     |                | 44        |
| Epitheliomata | Basal cell     | 58        |
|               | Squamous cell  | 61        |
|               | Capillary type | 3         |
|               |                | <hr/> 166 |

## Tumors in the skin

|                                     |          |
|-------------------------------------|----------|
| Fibromata                           | 38       |
| Sarcomata                           | 24       |
| Pigmented mole                      | 28       |
| Melanocarcinomata                   | 1        |
| Keloid                              | 9        |
| Granulomata                         | 7        |
| Fibroepithelial or composite tumors | 3        |
| Capillary angiomata                 | 2        |
|                                     | <hr/> 23 |

## 3 Tumors beneath the skin

|                            |          |
|----------------------------|----------|
| Angiomata (cavernous type) | 0        |
| Lipomata                   | 5        |
| Sebaceous cysts            | 8        |
| Implantation cysts         | 5        |
| Dermoid cysts              | 5        |
| Carcinoma metastasis       | 1        |
|                            | <hr/> 64 |

About 45 per cent of these tumors then are epitheliomata sarcomata and melanocarcinomata and if we omit the basal cell epitheliomata from this percentage we find at least 28 per cent of the tumor presenting morphological characteristics of malignancy.

Fortunately this does not at all accurately represent the relative frequency of incidence of malignant neoplasms of the skin for it is well understood that many of the tumors re-

moved whose benign character is clinically evident (tumors such as lipomata and sebaceous cysts) are not sent to the laboratory for diagnosis

On the other hand it must be remembered that a few tumors which in their early stage appear both clinically and morphologically to be non-malignant give unmistakable evidence later (by metastasis) of their autonomous character. And these growths cannot but excite our peculiar interest.

Leaving their detailed consideration for a later moment let us now examine the group of epitheliomata sarcomata and melanocarcinomata among the laboratory specimens with reference to the clinical diagnosis made by the sender of the specimen.

Among the 64 squamous epitheliomata there were 0 correct diagnoses and 27 cases in which the sender was either too indifferent or lacked the confidence to record his diagnosis. It is perhaps fair to argue that the sending of the specimen was inferential evidence that the operator at least suspected possible malignancy. Among the 58 basal cell epitheliomata there were 9 correct diagnoses, 13 incorrect diagnoses and 36 cases with none. Of the 1 melanocarcinomata 4 were incorrectly diagnosed and 4 had no diagnosis recorded. Five of the 4 sarcomata were correctly and 8 incorrectly named and 11 were not recorded.

Analyzing these figures we find 25 per cent of straightforward recorded mistakes failures clinically to detect epithelioma, 6 per cent of failures to recognize basal cell epithelioma, 33 per cent mistakes in melanocarcinoma and 33 per cent in sarcoma.

These facts are sufficiently striking to raise again the old question (most pertinent of cutaneous new growths) How do you know a malignant tumor when you see one?

An attempt to answer lead us to a brief review of the clinical characteristics of cutaneous tumors in general without drawing any hair lines between hypertrophy and new growth.

Situation, size and surface appearance, consistency, pigmentation or the lack of it, but above all the presence or absence of ulceration and the rate of growth are the

important details to be observed in the examination of any skin tumor.

Following the outline of our tentative classification we may say that for purposes of clinical surgery all new growths upon the skin not epitheliomata may be called papillomata. Now in any respectable treatise upon diseases of the skin at least ten varieties of verruca or warts may be discovered but most of these agree in their description with what surgeons are apt to designate papilloma and this term connotes lexicographically. Any excrescence upon the cutaneous or mucous surfaces although morphologically speaking papillomata are outgrowths from the surface having a covering layer of epithelium and a connective tissue framework.

Such tumors indeed may be many in number various in form size shape and appearance but no matter how different the histologic features an accurate positive clinical differentiation cannot be made between the varieties except it be based upon their situation or the history of their origin and course.

Exceptions perhaps to the very general rule are the cutaneous horns rarely seen (but never afterward to be forgotten) and of little surgical significance except for the possibility of epitheliomatous change which Lebert says occurs in 1 per cent of the cases. Also the common corns and callosities (which are what every woman knows) and which though (like horns) of enormous etiological, histological and phylogenetic interest are too familiar to require any mention further than to record that occasional confusion may arise between an early melanotic growth and a corn upon the sole of the foot because of the minute hæmorrhagic extravasations that are frequently found simulating pigment in the deeper layer of the latter.

Now epitheliomata are found in our experience most frequently upon the forehead (15 per cent) the lips (13 per cent) and the cheek (14 per cent) but while the basal cell favors the cheek nose and forehead they may occur on any part of the surface. Nor in the early stage is there anything absolutely characteristic in their size shape or consistency. True they are generally hard. But so

are many papillomata and it is not until the former are so to speak full blown and well developed (especially in the basal cell type) that evident acceleration of the rate of growths and the development of ulceration afford fairly definite evidence of their wicked identity.

Among the tumors in the skin fibromata and sarcomata so closely resemble each other at the period when local removal has curative possibilities that even under the microscope a diagnosis may be doubtful and the elements are so mixed that the term fibrosarcoma has arisen to conceal our ignorance. The same may be said with regard to angiomata although of course the perfectly typical instances may be easy to differentiate.

Keloids are usually so straightforward as to be positively uninteresting (from a diagnostic point of view) but we have at least one specimen of clinical keloid that turned out to be on microscopic examination a basal cell epithelioma.

But any fungating tumor may be mistaken for a granuloma and between a melanotic carcinoma and a pigmented mole no pathognomonic symptom can be stated that will definitely point to removal for malignancy while yet local removal is of any value.

Tumors *benign* of the skin present some diagnostic difficulties as between certain angiomata and lipomata but these are unimportant from the standpoint of mortality while sebaceous implantation and dermoid cysts although exciting to the dilettante to argue over for the most part share the same ignominious degree of safety.

If a wearying repetition of too well known symptoms has been avoided enough has yet perhaps been said to indicate that although in what might be called the developed stages acceleration of growth rate and occurrence of ulceration are most pointedly suggestive of danger in the developing stages on the other hand a positive correct diagnosis between the benign and a malignant tumor of the skin can rarely be expected. If this be true and our records speak loudly in its affirmation it follows as the night the day that the only question a clinical surgeon has the right to hagggle over

is whether the offensive excrescence is a real new growth or not i.e. whether it has grown since first noticed.

If it be then it must come out for to paraphrase the old story of the good Indian the only permanently benign tumor is one that has been bottled early.

And now lest this presentation may have robbed the subject of its proper gravity your attention is most seriously invited to two propositions.

1 That every new growth of the skin should be excised as soon as one can decide that it is a new growth.

2 That if any suspicion of present malignancy is entertained and local excision is thought adequate a much wider incision of the tumor should be planned than has commonly been practiced in the past. And in support of these propositions I have selected from a number of others filed in the laboratory three malignant cutaneous neoplasms with histories of their courses.

1 No 1830 illustrates the danger of waiting for rapid growth and ulceration.

No 775 illustrates the same.

3 No 546 illustrates the futility of close excision.

Fannie Beckner No 75 Admitted Febuary 5 1904 P.O. Hotel Hospital History No A460 Chief complaint sore on left heel and swelling in left groin Six months ago patient first noticed a small eddenned swelling on left heel. There was some tenderness and the skin was rubbed off and there was crissal bleeding but no pus. The swelling did not go perceptibly larger but the surface became ulcerated and did not heal and there developed little black nodules about the ulceration. Three weeks ago she went to Vanderbilt Clinic. She was seen by Dr. Breder who made a diagnosis of papilloma. The entire area was excised and the specimen sent to Dr. Clarke (January 1904) who made a diagnosis of melanocarcinoma.

The outer margins healed but the central part remained an ulcerating area. Since the excision of the mass in the foot the patient has noticed presence of small nodules in the left groin associated with sensations of dragging and pressure in the inguinal region and indefinite pain in the leg. She had no difficulty in walking but bleeding has lost a little in weight.

Examination of left heel inner aspect shows an ulcerating area about the size of a five cent piece. The edges are slightly raised and show small dark areas with brown pigment. On the skin in the

immediate neighborhood are three raised pigmented nodules.

In left groin are palpable two distinct firm masses about the size of an English walnut not red or tender no fluctuation seem firmly attached to deep structures. Few small palpable kernels in right groin.

First operation February 6 six months after discovery of growth. Two glands excised and sent to laboratory for frozen section. Report chronic inflammation. Further examination of glands showed melanocarcinoma.

Second operation February 16. Amputation at hip done under the impression that there was yet no metastasis in glands.

A letter from Dr S. Follitt to Dr Russell of the Roosevelt Hospital received July 3, 1914 twelve months after tumor was first noticed six months after first excision reads:

I learn from Dr. Beers that a lady which I have recently had been under your care at the Roosevelt Hospital in January. An elderly man Mrs. Bernicker had a malignant growth near the ankle. You amputated at the hip joint. Within a month of her discharge from the hospital as nearly as I can get the fact she began to develop little tumors under the epidermis. When I asked her she had about fifty such nodules arising from a small hot to a almost freely maligant scattered over the ntegment of the trunk and neck of skin normal. I excised one of these tumor and enclosed a section.

The woman's complaint of various nodular pain. Nodules can be made out.

Skin nodules July 1914 show a small focal area forming a definite tumor of epitheloid cells with supporting fibrous stroma. No pigment. Dr. Follitt reports that she died date unknown.

Henry Kelly 3 years old No. 2346 Epithelioma of elbow region metastasis in axillary lymph nodes. Death from visceral metastasis and spinal metastasis twenty three months after excision of primary growth and about twenty five months after it began to grow rapidly.

Primary History May 22 1913 from Vanderbilt Clinic. Fungating mass 1.8 inches in diameter on outer side of left forearm just below elbow. Commenced three years ago as a small mole (rown to present size in two months) rapid growth for two months.

Sent to the Roosevelt Hospital from Vanderbilt Clinic January 1914 (eight months after excision of primary growth on arm). Then had mass of tonsil enlarged nodes in left axilla attached to deeper part. On operation node found not adherent to sheath of axillary vein. Node excised is thoroughly a possible. Wound healed *per primam*.

March 1914 (two months later) no palpable recurrence in axilla but he spit up a little blood and complains of occasional sharp pain in left shoulder region (Query—lung metastasis or exacerbation of chronic bronchitis?).

April 1914 (three months later) Recurrence (local) noted in axilla. On operation gristly hard mass found adherent to sheath of axillary vein. Mass excised as completely as possible (vessel should have been removed also). Wound healed *per primam*.

July 1914 (six months later) Second local recurrence was observed in scar and deep axilla. Dr. Hotchkiss operated. A mass was found involving the axillary vessels which were almost completely surrounded by it and so compressed as to be nearly obliterated. Neoplasm and about four inches of axillary vessels removed *en masse*. Wound never entirely healed.

September 1914 (8 months later) The patient complained of pain in both shoulders and sides of chest—(Query—Spinal metastasis?). Some induration of margin of unhealed wound. Loss of flesh and strength noted. Codeine 4 grain per day begun.

October 1914 (9 months later) The patient was suffering much pain. General condition decidedly cachectic. Evident local recurrence in unhealed suppurating skin wound and one nodule elevated and size of hazel nut in anterior axillary fold and similar one in posterior fold. Now taking morphine sulphate 1½ grain every day.

December 1914 (11 months later) Death rather sudden but with no definite ascertainable symptoms of hæmorrhage or embolus. He had been taking less and less nourishment lately. Not able to leave bed past three days.

Bertha Vanderen age 53 years German No. 1830. Sixteen years ago (after childbirth) the patient noticed warts on right side of forehead which were dark colored. The skin around them gradually became dark. A few months ago lower wart began to grow high and its top to ulcerate. Fourteen days ago the patient noticed a lump on the right cheek. This has increased in size and become tender. Two or three other small lumps also appeared in neck below the angle of jaw. One slightly tender. On right side of forehead just below the hairline is a dark brown wart about two inches in diameter which looks like a birthmark. Near the center is an ulcerated papillomatous growth nearly one fourth of an inch in diameter with considerable purulent discharge. It is friable and bleeds easily. Another papilloma appears in upper anterior part of the dark area but this is smaller and not ulcerated. In front of the auricle a small oval smooth tender mass (apparently parotid lymph node) about one half by three quarters inch and below the angle of the jaw are several others.

On the second day after admission signs of suppuration appeared on the neck and an incision was made. The parotid node was smaller and softer.

On the twelfth day after admission the area on the forehead was excised.

On the forty second day the lump in the parotid was excised.

About three months after excision of the primary growth a recurrence was noted about the excised

area Seven months later recurrence in neck. An attempt was made to remove this but it was too deep and involved great vessels and nerves. From this time on growth became very rapid finally causing constant severe pain dyspnea and dysphagia. Many small local recurrences dotted her forehead and right side of face.

Nine months after the original operation (about eleven months after tumor began to grow fast) a block dissection of neck done for relief of dyspnea. Patient died on operating table.

With these three fatal examples before us of the many mistakes that have been honestly recorded and bearing in mind the ease and

safety of early removal of skin tumors is it not fair to ask the general practitioner to forget the minute differences between the ten varieties of warts and remember only that of cutaneous neoplasms in or upon the skin a large percentage are or will become malignant?

A source of chronic irritation removed a precancerous lesion excised is more valuable by far than many a treatment of developed cancer if there be any truth in the old adage that an ounce of prevention is worth a pound of cure.

## FURTHER STUDIES IN POSTOPERATIVE PNEUMONITIS<sup>1</sup>

By C. N. MATHER, CLEVELAND, M.C. USA  
L. H. P. IN

**D**URING the years 1915 and 1916 the subject of postoperative pneumonia at the Presbyterian Hospital was carefully studied by Whipple (1) and reported by him in SURGERY GYNECOLOGY and OBSTETRICS January 1918. The work has been continued for another year for comparison with the statistics of the preceding two years and also to observe the effect of certain prophylactic measures which had been instituted. A special analysis sheet has been used in each case of postoperative pneumonia to insure a uniformity in ascertaining data. A copy of this sheet is again published with this paper since it shows the line along which our investigations have run and it may be of interest in the development of comparative work by others (Fig. 1).

There has recently appeared in SURGERY GYNECOLOGY and OBSTETRICS a very comprehensive study of postoperative pulmonary complications by Cutler and Morton (2). A considerable part of this work deals with pneumothorax mediastinitis and pulmonary embolism of mechanical origin and which of necessity does not come within the scope of this present article dealing only with inflammatory conditions of the lungs following surgical operations. It will be in

teresting to contrast certain of the statistics of Cutler and Morton relating to postoperative pneumonia with those of the 1915, 1916 and 1917 series of the Presbyterian Hospital.

Previous to Whipple's work there had been reported no series of postoperative pulmonary inflammations in which the bacteriology had been carefully studied. Roentgenography as a routine procedure in all cases had likewise been neglected and the bedside history analysis of the complication had been very meager. With these facts lacking any work on postoperative pneumonia must be very incomplete.

It seems advisable to divide quite arbitrarily postoperative pneumonia into at least three types:

1. The true postoperative pneumonia often called ether pneumonia, a disease coming on within the first few days after operation accompanied by cough, rise in temperature usually due to some exposure.

2. Embolic pneumonia occurring at any time after operation and as far as is known one of the accidents of the postoperative course.

3. Terminal pneumonia occurring usually as an incident in patients in extremis after a short or protracted postoperative course.

## The Presbyterian Hospital

N T C T Y O E W Y O R K

W 3 H to N  
N me A Dr so

Op tion  
Operator Dr Anæsthetist Time of Anæsth a

Untoward Symptoms Occurring During Anæsthes

Cya o (1) Vom t g (2) E ss ve m c (3) Aspr at f v m t (4)  
H story of Rece t Co curr nt Re pir tory T oubi Bef r Entering Ho p tal  
Rec t c ld (1) C gh (2) B cht (3) T lts (4)  
E posu d n g exam to (1) f low g dm b th (2) f m operat g room to ward w th l gth  
f t me (3) aft r operat on tll pat e t i bed (4) w d lte ope ton (5)

M de of Life and Hab ts of Patient

Works -doors (1) t d rs (2) wea tt d rw (3) wool d rwea e s t (4) more tha  
t (5) takes cold b ths (6) hot b ths (7)  
N mbc f bl k t pate t leep de 1 2 3 4 etc

Patent Has on Admiss on Phys cal S gns of Inflamed Condition of Respiratory Tract

Rh t (1) To lts (2) Rh rnyrt (3) Lary git (4) B onch t s (5) Pulmo ry T be culo (6)

Cardio Vascular s d Renal Systems on Admiss on

N rm l (1) V lvul D sea (2) A rhythm (3) T chyd d (4) I ffi cy (5) Th ke ed P phe al  
Arte e (6) Hypert with Blood P e re (7) N phnt (8)

D e

Symptom f Onset in Order of Appearance With Date (underline important one)

C gh (1) P h t (2) Dy p oia (3) Ch ll (4) Rap d esprat n (5) Cy o (6) Temp t  
(7) R ty sp t m (8)

Ma k d Symptoms during Atta k (unde lin imp rtant o )

Co gh (1) P h t (2) R p d resprat n (3) Cya (4) R ty p t m (5) H p (6)

Tempe ture R m ned Over 102 F ( ote number of d ys 1 2 3 4 5 etc)

Blood Count D te W B C Differenti l

S gns of Congestion or C n lidatio Made O t m

R U L (1) R M L (2) R L L (3) L U L (4) L L L (5) E t R ght (6) E t Left (7)

Co gest o D te  
Co sold t o lob l (1)  
C ldat lob (2)  
X ray h d w w th o g of o sold t o D t  
S g f sold t o w th no X y h dow D t  
X y h d w d g f co sold t gr D te  
X y howed h d w bef gn f sold t pp d  
X y howed wedg h ped h d w D t  
No X ay take

Card V scular and R i Sy t m During th D a

Blood Pressure

Pulse St g (1) W k (2) Reg lar (3) I reg l r (4) R t

Heart A bythm (1) F b l t t (2) T hy rd (3) I ffi e cy (4)

K d eys

Alb m (1) N ph t (2)

C mpli t

Emphyem (1) Lu g bsc (2) Sero-fibrn pl y (3) Ot t (4) Peritoneal absces (5) P mococcu  
p t t local (6) D ff (7)

P t p at ve Respir tory D Oth r Than Pn um na

B h t (1) Ple y (2) Embol (3)

Ba t nology

P e mococ I (1) II (2) III (3) IV (4) No hæm lyt St ptococcus (5) Hæm lyt c Streptococ  
(6) Bac ll I fl za (7) Fri dl d r B c il (8) N rga m rec ver d (9)

A te-operat e p t m D t  
P t perat e p t m D te  
Bl od c lt D t  
Aggl t t

Blood w th sp t m A te-ope t (1) P tope t e (2)

Pr phyla ti M ur

P m a bed j ck t (1) D g tal M XV 4 d (2) B th R les (3) Co er rr t t w th l m t  
(4)

T tment

Ope (1) Serum (2) C p t t (3) D g tal (4) Oth t m l t  
F l res lt A t psy

Fig 1

This is more often discovered by the pathologist than by the clinician. There are often no physical signs usually no abrupt rise in temperature and no cough. This type of pneumonia is merely mentioned in this article as a matter of interest and will be

summarily dismissed. It is outside the scope of any work attempting to consider the prevention of postoperative pneumonia. During the year five of these terminal pneumonias usually bronchopneumonias were found by the pathologist in autopsies on



surgical patient. None of them presented clinical sign.

There were noted several cases of postoperative bronchitis during the year. These were uniformly mild clearing up within two or three days.

Postoperative pleurisy with effusion occurred once. The patient had severe pain in the chest with a temperature of 101°. Signs of fluid appeared at the right base and 600 cubic centimeter were aspirated.

In this present work only pneumonitis *per se* exclusive of those terminal pneumonias not recognized clinically will be dealt with in order to compare result with those obtained by Whipple. The embolic pneumonias will be considered separately frequently contrasting them with the postoperative pneumonias.

#### INCIDENCE

The postoperative pneumonitis encountered at the Freyberian Hospital during 1911 is divided as follows:

|   |   |   |    |   |
|---|---|---|----|---|
| P | t | t | p  |   |
| I | t | t | mb | p |
| f | t |   |    |   |

Out of 1940 operations during the year this gave a morbidity percentage of 3 which is high but at the same time there has been a disappearance of the unexplained so-called postoperative reaction. Every case with a temperature of 101° or over after operation without the presence of known infection has been carefully examined for signs of pulmonary involvement and has been radiographed. The latter procedure not infrequently gave the clue to the rise in temperature some time before physical signs appear. In a number of cases the signs never do appear. The increasing morbidity percentage of postoperative pneumonitis in our series 1 we are convinced is tribute to greater diagnostic accuracy and keener observation rather than any actual increase. The physical signs in this series have in no instance been covered without turning the patient and listening at the base of the lungs.

Referring to Table I the relation of ap

TABLE I

|    | I  | re<br>m<br>mbe | Embol<br>P<br>m<br>mb<br>C<br>es |
|----|----|----------------|----------------------------------|
| M  | 45 | 4              |                                  |
| I  | 3  | 3              |                                  |
|    | 58 |                |                                  |
| M  |    | 5              |                                  |
| I  |    |                |                                  |
| M  |    | 6              |                                  |
| I  |    |                |                                  |
| S  | 6  | 4              |                                  |
| O  |    |                |                                  |
| N  | 5  | 6              |                                  |
| D  |    |                |                                  |
|    | 9  |                |                                  |
| I  |    | 8              |                                  |
| O  |    |                |                                  |
| 3  | 39 | 3              | 5                                |
| 4  | 49 | 9              |                                  |
| 5  | 9  | 4              |                                  |
| 60 | 69 |                |                                  |
|    |    | 58             |                                  |

pearance to (1) sex (2) season and (3) age may be appreciated.

1 Sex. While the embolic pneumonias were nearly evenly divided between men and women the postoperative pneumonias were present in men four times as frequently as in the women. It may possibly be due to the fact that the women are less exposed to coughs and colds than men and that the oropharynx is not so chronically inflamed in women.

2 Season. The influence of the season on the occurrence of the postoperative pneumonias is seen when 65 per cent practically two third of the cases occurred during the six winter and spring months. No explanation for the relatively large number of postoperative pneumonia in August can be advanced unless it was due to a general relaxation of prophylactic vigilance toward the end of the summer. The embolic pneumonias were widely distributed no two within the same month. This is what might be expected.

3 Age Fifty two per cent of the cases of postoperative and embolic pneumonia occurred in the third and fourth decades agreeing almost exactly with Whipple's findings. Only four of the patients were over 60 years of age. These figures differ quite materially from those of Cutler and Morton. In their series of 40 postoperative pneumonias 67 per cent were over 40 years of age.

#### PREDISPOSING FACTORS

Among the predisposing factors of postoperative pneumonia are the following: (A) coughs, colds, etc. previous to or on admission to the hospital; exposure to cold while in the hospital; (B) condition of the patient; (C) type of operation; (D) anæsthesia.

A *Coughs, colds and exposure.* The great importance of this subject warrants a detailed discussion (see Table II). Of the six

TABLE II

|  |   |
|--|---|
| Patient given history of recent cold within 30 days to a month before admission  | 6 |
| Patients given history of exposure to cold in admission bath or change from heat under ether to cold ward clothing   | 4 |
| Patient given history of exposure from pneumonia in influenza after operation  | 1 |
| Patient has in one instance physical signs of an acute inflammation of the respiratory tract, acute bronchitis, acute tonsillitis, acute rhinitis, etc.            | 1 |
| Patient has in one admission physical signs of low grade or chronic inflammation of the respiratory tract, such as hypertrophied tonsils, chronic bronchitis, etc. | 8 |
| Total cases  | 4 |

teen patients who gave a history of having had a cold before admission, three had previously been sent home to recover and returned apparently cured. None of these patients showed any physical signs of inflammation of the respiratory tract. The risk of catching cold from exposure following the admission bath has been largely eliminated during the war. Two women patients caught cold from failure of their hair to dry properly after their bath. The electric dryer was installed directly after this. Exposure after operation from insufficient covering draughts from windows, etc., claims its fair share of victims. Some patients, owing to restlessness when coming out of anesthesia, are of

course very difficult to keep properly protected against exposure. The five patients entering the hospital with acute inflammation of the respiratory tract were exceedingly poor risks from the standpoint of pneumonia, but they were all emergency operations and the surgeon was left no choice in the matter. The low grade inflammations of the respiratory tract noted range from hypertrophied tonsils to chronic bronchitis and are doubtless important predisposing factors. The chronic respiratory ailments are extremely prevalent and the only way to be sure of their importance would be to note them carefully in the physical examinations of all patients about to undergo operation and see what percentage developed postoperative respiratory disease.

B *Condition of patient.* This series offers a relatively small number of cases of the aged and infirm, but there are several instances of those worn down by the cachexia of malignancy or constitutional disease falling in easy prey to postoperative pneumonia. Under the heading of condition of the patient it will be well to consider the average type which comes to operation at the Iresby Memorial Hospital. Of the 63 cases in this series the occupation of 6 was ascertained. Of these 33 worked indoors while only 9 worked in the open air. The great majority stated that they changed from heavy to light underwear according to the season and took hot or cold baths by the same token. In regard to general physical condition 59 of the patients were examined and 78 per cent of these were recorded as having normal cardiovascular and renal functions in so far as routine physical examinations and urinalysis showed. Six patients had albuminuria, three with cysts; one patient had slight cardiac insufficiency and another hypertension of 195/105. It will thus be seen that roughly speaking these patients were in good physical condition, though as a class they are quite susceptible to change in temperature.

C *Type of operation.* (Table III). Eighty-six per cent of the operations performed in this series were calotomies and a majority of these were of a relatively simple nature.

TABLE III—SUMMARY OF OPERATIONS

|                      |    |
|----------------------|----|
| Hernia               | 9  |
| Gastrointestinal     | 6  |
| Appendectomy         |    |
| Pelvic gynecological |    |
| Colic                | 7  |
| Enterostomy          |    |
| Gastroenterostomy    |    |
| Enterocolostomy      |    |
| Ileocecal            | 3  |
| Mesenteric           |    |
| Stomach              |    |
| Thyroid              |    |
| Decompression        |    |
| Phlebotomy           |    |
| Lumbar               |    |
| Tumor                | 6  |
| Tuberculosis         | 56 |

such as hernia repair and removal of simple appendix. These findings lend added weight to the argument that those operations which tend to limit respirations by splinting the abdominal or thoracic muscle predispose to postoperative pneumonia. In Whipple's series 90 per cent of the operations were coeliotomies. Cutler and Morton likewise ascribe to restricted respiration the high percentage of postoperative pneumonia following coeliotomy particularly after epigastric incisions. In this series there were eight epigastric incisions which is certainly a relatively high percentage of the total of such incisions.

**D. Anesthesia.** Time was when the entire blame for postoperative pneumonia was laid at the door of an anesthesia. Ether pneumonia was a term well known and widely circulated. The surgeon was only too willing to shift the blame to the anesthetist or consider the pneumonia as one of those unavoidable accidents of the postoperative course. That the anesthetic *per se* does not cause the pneumonia is no longer doubted. The irritation of the anesthetic does, however, prepare the way for organisms already present in the upper respiratory tract by lowering the resistance of the lung tissue. The commonest organism present in the mouth is the pneumococcus group IV which is indeed the one most commonly responsible for postoperative pneumonia. Patients markedly obstructed with mucus during the anesthetic may very easily aspirate a considerable quantity loaded with organisms

from the mouth. In six cases it was noted that there was considerable mucus causing obstruction to breathing. Cyanosis due to obstructed respirations was present in 14 cases. This condition is simply an indication of insufficient aeration or oxygenation of the blood and a congestion of the pulmonary vessels and favors a descending infection according to Whipple. The anesthetic of choice has been gas and ether by the closed method with the Bennett apparatus though recently there has been a trend toward ether by the drop method. This latter certainly tends less toward cyanosis. Ether has rarely been used during the year where there was any inflammatory condition of the respiratory tract that was considered a risk from the standpoint of postoperative pneumonia. Gas and oxygen, local anesthesia and chloroform are used in such cases. Table IV shows the number of cases developing pneumonia after the various anesthetics. The number following chloroform is large in proportion to the total number of chloroform anesthetics but these cases were almost invariably bad risks.

TABLE IV

|                |    |
|----------------|----|
| Chloroform     | 44 |
| Ether          | 7  |
| Gas and oxygen | 3  |
| Local          |    |
| Total          | 6  |

The cases were divided among the various anesthetists, professional and members of the house staff about in proportion to the number of anesthetics given by each. The length of anesthesia had very little if any influence. The shortest in the series was three minutes and the longest two hours and twenty minutes with an average of sixty two minutes.

Before further detailed consideration of the postoperative pneumonias encountered in this series the routine followed in their study should be understood. A preoperative sputum examination was made on all patients. As soon as a patient came under suspicion of postoperative pneumonia whether for a sudden rise in temperature, cough or

pain in the chest with or without the presence of physical signs the following measures were taken (1) postoperative sputum examination (2) blood count leucocytes and differential (3) blood culture (4) urine for pneumococcus precipitation test (this latter has been in use only since September 1917) (5) roentgenograph of lungs

The type of postoperative pneumonia which it is our object to emphasize has most frequently occurred in otherwise healthy young adults. In our 58 cases an attempt was made to subdivide them into lobar and lobular with the aid of the roentgenograph to check up physical findings. This is a rather crude method of stating the extent of the consolidation. Twenty six of the cases were lobular and twenty eight lobar four were undetermined.

#### SYMPTOMATOLOGY

(SEE TABLE V)

A typical case of postoperative pneumonia has very definite characteristics of its own. The average time of onset is 48 hours after operation though that of 55 per cent of the cases occurred within 24 hours after operation. A sudden rise in temperature to about 103 or cough or less frequently pain in the chest may mark the onset. There is rarely an initial chill. During the course of the disease the temperature falls by lysis within a day or two. In this series it remained over 102 for an average of only 5 days. The most important symptom during this period is cough as shown in 66 per cent of the cases followed by rapid respiration and pain in the chest respectively. In the meantime signs of consolidation usually appear at either base and the roentgenogram shows the shadow. This disease *per se* uncomplicated by cachexia, debility or by any other constitutional disturbance has not proven itself a dangerous complication in this present series.

In strong contrast to the foregoing embolic pneumonia has likewise very definite earmarks. The average day of onset was the twelfth day after operation. The most important symptom of onset was pain in the chest in six out of the seven cases. The temperature falls by lysis after persisting for seven

TABLE V—SYMPTOMS

| Symptom                              | Post operative<br>P<br>58 Cases | Embolism<br>7 Cases |
|--------------------------------------|---------------------------------|---------------------|
| Cough                                | 41                              | 1                   |
| Temperature                          | 39                              | 6                   |
| Pain in chest                        | 19                              | 7                   |
| Rapid respiration                    | 32                              | 1                   |
| Cyanosis                             | 10                              | 1                   |
| Dyspnoea                             | 9                               | 1                   |
| Chill                                | 3                               |                     |
| Rusty sputum                         |                                 | 1                   |
| Average day of onset after operation | 2 4                             | 7                   |
| Symptoms during attack               |                                 |                     |
| Cough                                | 44                              | 5                   |
| Pain in chest                        | 16                              | 5                   |
| Rapid respiration                    | 40                              | 5                   |
| Cyanosis                             | 6                               | 2                   |
| Dyspnoea                             |                                 |                     |
| Rusty sputum                         |                                 | 2                   |
| Herpes                               |                                 | 1                   |
| Temperature remained over 102        |                                 |                     |
| Never reached 102                    | 1                               |                     |
| 1 day                                | 11                              | 2                   |
| 2 days                               | 7                               | 0                   |
| 3 days                               | 4                               | 1                   |
| 4 days                               |                                 |                     |
| 5 days                               | 3                               | 1                   |
| 6 days                               |                                 | 1                   |
| 8 days                               | 1                               | 0                   |
| 9 days                               | 1                               | 0                   |
| 10 days                              |                                 |                     |
| 15 days                              | 0                               | 1                   |
| 9 days                               | 0                               | 1                   |

or eight days. The pain in the chest continues as the most important symptom throughout. Cough is usually present and in about one third of the cases blood tinged sputum was noted. The signs in the chest are those of consolidation often preceded by pleuritic friction rubs. The roentgenograms checked up the physical findings in every case in which it was employed.

#### PHYSICAL SIGNS

The physical signs of consolidation of postoperative pneumonia in our experience have invariably been found in one or the other lower lobe usually at the extreme base. These signs may be easily missed unless the patient is turned over on his side and the bases are carefully searched with percussion and auscultation. Any patient can be turned after operation without danger if proper care and gentleness are exercised. In the postoperative pneumonias the signs usually appear with the onset or shortly after in about 70 per cent of the cases within the first 4



pointing downward and outward. This peculiarity has been mentioned by Whipple and others.

In the great majority of cases the roentgenogram agrees with the physical signs proving it a valuable and conclusive aid in the diagnosis. The details of the roentgenographic shadow in relation to physical signs may be seen in Table VI.

#### COMPLICATIONS

Complications directly due to the pneumonia arose in six cases of the postoperative and two of the embolic pneumonias. The most frequent of these complications was serofibrinous pleurisy occurring in three postoperative pneumonias. In none of these was an organism recovered on culturing the fluid. Another postoperative pneumonia developed a serofibrinous pleurisy from the fluid of which a gram positive diplococcus was recovered. This same patient also had a marked localized pneumococcus peritonitis and was jaundiced. Jaundice occurred in one other patient. These pleural effusions mentioned were uniformly small and relatively unimportant.

The most serious complication noted among the postoperative pneumonias was a lung abscess following a delayed resolution for five weeks. This patient eventually recovered without operative treatment.

The embolic pneumonias had far more spectacular complications. One patient with a hemolytic streptococcus in the blood culture and sputum developed an empyema which was drained by rib resection and thoracotomy. The pus likewise yielded a pure culture of hemolytic streptococcus. A second embolic pneumonia with a staphylococcus aureus present in his blood culture developed a small pleural effusion. The fluid removed was tinged with blood which very probably accounts for the presence of the staphylococcus aureus in the culture. The effusion soon cleared up.

#### BACTERIOLOGY

In the study of postoperative pneumonia the greatest importance has been placed upon this aspect of the work. We have been

fortunate in having the services of a thoroughly scientific bacteriologist, Miss Marion Olmstead, who has followed the subject of postoperative pneumonia during the entire three years covered by the present work and that of Whipple. We have been particularly anxious to learn what organism or organisms are responsible as direct causative factors in the disease. This has meant a large increase in the routine work of the bacteriologists, but has been carried out with a splendid spirit of co-operation. The preoperative and postoperative sputum examinations and blood cultures and blood agglutination should have been done in every case as was intended. The failures represent a certain carelessness on the part of the nursing and house staff and include a few private patients on whom permission to obtain specimens was withheld. The urine precipitation test was not adopted until September, 1917, but since then has been tried consistently.

1. *Sputum* (see Table VII). A little less than half of the preoperative sputum examinations showed no pneumococcus present, but after operation this was reduced to one sixth. Of the organisms present the pneumococcus group IV holds the pre-eminent place, being present in 32 per cent before operation and in 57 per cent after operation in cases developing postoperative pneumonia. The other groups of pneumococcus were all represented except group I. Hemolytic streptococcus and bacillus mucosus capsulatus also were occasionally found. In 17 cases the preoperative and postoperative sputum examinations showed the same organism, 10 of these showing pneumococcus IV.

2. *Blood culture*. This test was made in fifty-one cases of postoperative pneumonia and found positive in but three. Pneumococcus group IV was present in the blood of one patient, non-hemolytic streptococcus in that of another, both of whom recovered and finally pneumococcus group III was found in the blood of a third who died.

In the embolic pneumonias with two positive blood cultures out of seven the incidence was much greater in proportion as might be expected. In one case hemolytic streptococcus was present in the blood both before



TABLE IX

| H p t l                            | N<br>Cases | P<br>M m<br>b d t y | M<br>P r c<br>t g | M r t l y | M r t l y<br>P | M r t l y<br>I C<br>M b d t |
|------------------------------------|------------|---------------------|-------------------|-----------|----------------|-----------------------------|
| Mayo (Beckman) 1910 (3)            | 657        | 10                  | 0 27              | 5         | 0 14           | 50 0                        |
| Mayo (Beckman) 19 (4)              | 5835       | 19                  | 0 32              | 0         | 10             | 31 5                        |
| Mayo (Beckman) 1913 (5)            | 68 5       | 7                   | 0 39              | 0         | 0 0            | 0 0                         |
| Roosevelt Hospital N Y (L S B) (6) | 1612       | 23                  | 0 9               | 7         | 0 26           | 30 4                        |
| New York Hospital F W B (7)        | 14 3       | 15                  | 1 06              | 7         | 0 50           | 40 6                        |
| Mass General E C C L J J M         | 3490       | 40                  | 1 14              | 22        | 0 63           | 55                          |
| Montreal General Armstrong (9)     | 2500       | 30                  | 1 20              | 22        | 0 88           | 73 3                        |
| Leipzig Læwen (8)                  | 9755       | 180                 | 1 8               | 113       | 1 15           | 63                          |
| Presbyterian A O W 915 16          | 3719       | 9                   | 2 1               | 25        | 0 66           | 25 7                        |
| Presbyterian M C                   | 1940       | 65                  | 3 3               | 7         | 0 36           | 10 7                        |

postoperative sputum This test has only been tried during the last four of the twelve months during which this series runs. It was positive in five out of sixteen cases which is a somewhat higher percentage than the agglutination test. In one case in which the bacillus mucosus capsulatus was recovered in both pre operative and postoperative sputum the test was positive for pneumococcus group I showing that although the sputum failed to demonstrate it there must have been a group I infection. When the pre operative and postoperative pneumococci were of different strains of the same group the precipitation held for one strain only.

The result of the bacteriological investigation has been to establish the specificity of the causative organism in 18 out of 58 cases of postoperative pneumonias. In eleven of these the pneumococcus group IV was the causative organism. During the disease this organism was isolated from the sputum twice as frequently as all the other organisms combined. There can be but little doubt but that the pneumococcus group IV is in most instances the cause of that definite and distinct type of pneumonia already described and called in this instance postoperative pneumonitis. The bacteriology of the embolic pneumonias presents a different aspect. In one instance the positive blood culture may be the cause of the pneumonia by a bacterial embolus. The pneumonia may possibly in another instance be the result of a secondary infection of an embolus already present in the lungs. The pneumococcus group IV was however found most frequently in the sputum of pneumonias of this type as well as in that of the postoperative pneumonitis.

## MORTALITY

In considering the mortality in postoperative pneumonia attention should be paid to whether or not the patient died as a result of his pneumonia. There were seven deaths in the sixty five patients making the mortality 10.7 per cent. No one of these occurred where the pneumonia was the only complication in other words no otherwise healthy patient undergoing operation died as a result of his pneumonia. Malignancy claimed three patients one with carcinoma of the colon another with carcinoma of the oesophagus and a third with carcinoma of the cystic duct. All of these were in very poor condition. A pulmonary embolus caused one death. Another patient died in a diabetic coma following incision and drainage of an alveolar abscess. A mastectomy in a patient sixty five years of age not in very good condition resulted in a fatal pneumonia. The seventh patient died of inanition following a duodenal fistula rather than from the pneumonia. It is only fair to say that two other patients in the present series died in the hospital one a paraplegia with a positive blood culture died of sepsis six weeks after the embolic pneumonia had subsided the other died over a month after his pneumonia and from no associated condition. One of the most distressing tragedies of hospital experience is to see a young healthy individual undergo a simple surgical operation and die of postoperative pneumonia. During the past year we have fortunately been spared this perhaps due to greater care in prophylaxis.

For the greater part of Table IX the writer is indebted to Cutler and Morton



The Presbyterian Hospital statistics have simply been added. As the above mentioned investigator have pointed out the statistics from the Mayo clinic can in no way be compared to those of a general city hospital because their patients must be fit to stand railway journeys of varying distance. The low morbidity of this clinic is quite remarkable. Although the morbidity of postoperative pneumonia at the Presbyterian Hospital has been increasing during the past three years the mortality percentage has been falling even more markedly. The present series shows the highest morbidity percentage in Table IX, but it shows also by far the lowest mortality percentage. This leads to the question whether at the other clinics there might not have been the postoperative pneumonia not detected either clinically, which roentgenography and bacteriological investigation might have revealed.

#### TREATMENT AND PROPHYLAXIS

The following prophylactic measures have been instituted and followed out with considerable faithfulness during the past year.

1. Great care is taken to elicit a history of recent cold, cough, sore throat, etc., and in the physical examination the respiratory tract is given special attention. Patients with history of recent cough or signs of rhinitis, tonsillitis, pharyngitis, etc., are sent home to wait a week or two if their operation be one of choice.

In case of operation of necessity in patient with signs of inflammation of the respiratory tract ether is seldom used if it can be avoided. Chloroform gas and oxygen and local anesthesia have been used with such patients whenever possible.

With the experience gained from Whipple's work on the problem the following measures for prophylaxis were put in the form of rules for the nurses to observe:

1. The temperature of the bathroom for the routine admission bath must be 70° F.

No patient who has had his admission bath and is to be operated on the following day shall be allowed out of bed.

3. The hair of all female patients is to be thoroughly dried with an electric blower.

4. Before leaving operating room each patient shall be given a dry warm night shirt and be carefully covered with sufficient blankets.

5. On arriving in the ward a cotton pneumatic jacket shall be put on each patient.

6. Sufficient blankets must be provided and all draughts avoided.

7. As soon as the patient is conscious a heavy woolen bed jacket is to be worn.

(The rules relating to blankets, bed jackets, etc., did not apply during hot weather.)

Two additional experiments in prophylaxis were tried.

1. All the patients of one male ward were given tincture of digitalis 15 minims on admission and every four hours until they had 40 minims in an attempt to obtain a digitalis effect on the heart to combat pulmonary congestion during the operation.

All patients of another male ward had their chest rubbed with a turpentine camphor liniment immediately after operation.

Of these two measures the counter irritation seemed to be of some benefit and came into pretty general use throughout the hospital in case where any respiratory trouble was anticipated after operation.

The treatment of postoperative pneumonia is almost entirely symptomatic. If it should be due to pneumococcus group I serum is to be used. Fresh air by an open window and forced fluid were almost invariably used. Digitalis was used in 38 cases out of the 63 usually in the form of the tincture though occasionally digipuratum or digitalin was given intravenously. On rare occasion camphor or caffeine was given but when such stimulation was indicated it was of doubtful benefit.

#### CONCLUSION

1. Cough, cold, and other inflammatory conditions of the respiratory tract are the most important factors predisposing to postoperative pneumonia. Restriction of abdominal respiratory movement as a result of incision, postoperative distention, tight dressings is also a definite factor.

Exposure of the patients to cold while in the hospital before as well as after operation is responsible for a certain number of postoperative pneumonias.

3 The pneumococcus group IV is most frequently the inciting organism of postoperative pneumonia

4 The urine of patients suffering from postoperative pneumonia frequently develops precipitates against the organism recovered in the pre- or postoperative sputum while the blood develops agglutinins

5 The pneumonia due to pneumococcus group IV is a definite clinical entity differing from the pneumonia due to pneumococcus groups I, II or III

6 The use of the roentgenogram in all cases of suspected postoperative pneumonia

and the careful and constant search for physical signs will reveal more postoperative pneumonias than have hitherto been reported

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## HYDATIFORM DEGENERATION IN TUBAL PREGNANCY

### A REPORT OF FORTY EIGHT NEW CASES

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STRANGELY enough the occurrence of chorio epithelioma arising from tubal pregnancy seems to be better known and also better established than the occurrence of hydatiform mole within the tube. This is especially surprising in view of the stress laid especially by Marchand (1895) upon epithelial proliferation in cases of hydatiform mole and in view of the fact that trophoblast formation and epithelial proliferation in general have been regarded as being greater in tubal than in cases of uterine implantation. This is illustrated well by such cases as that of Teller (1903) in which it was found impossible to distinguish by histologic examination between the epithelial proliferation present in a case of tubal pregnancy and that from a chorio epithelioma. It seems to me that from the circumstances alone one might expect hydatiform degeneration to be relatively more common in the tube. Moreover when it is recalled that experts still regard it as impossible to decide the question of malignancy or benignity in case of suspected uterine chorio epithelioma on the basis of histologic preparations alone

this surmise gains more in probability. The presence of hyperactivity in the trophoblast in many cases of tubal pregnancy as compared with the uterine was confirmed also by personal observation and if as stated by Teacher (1903) chorio epithelioma arose from hydatiform moles in approximately 40 per cent of 287 cases and according to Seitz (1904) and Frankel (1910) in 50 per cent even the occurrence of hydatiform degeneration in tubal pregnancies can hardly be doubted because of this fact alone. Nevertheless of the 7 cases of tubal hydatiform moles cited by him Werth (1904) regards only the case reported separately by von Recklinghausen (1889) and by Freund (1889) as well authenticated. Werth reserves judgment however on the case of Mitwejew and Sykow (1905) a report upon which was accessible to him and to me in a short review only. Seitz however accepted the short review of this case as convincing nor questioned the case of Otto (1871) or that of Wenzel (1893) but incorrectly credits Wenzel with cases. Werth on the contrary regarded the latter cases and also that of

Croom (1889) which is accepted also by Veit (1910) as genuine as undoubted instances of simple hydropic degeneration of the connective tissue of the villi so common in aborted chorionic vesicles both from the tubes and from the uterus. But Werth unfortunately does not state just what he means by simple hydropic degeneration. Since he speaks of it as common in aborted ova one may conclude that he refers to changes in the chorionic vesicle while still within the uterus after its complete detachment from its implantation site. For want of a better term such changes may I presume be spoken of as maceration changes although they may not occur under sterile conditions. However I do not thereby imply that the change is similar under sterile and under putrefactive conditions. They undoubtedly differ.

Since Werth speaks of simple hydropic degeneration in aborted ova he does not I take it refer to a dropical condition of the villi possibly due to an obstruction of the venous return for such a condition necessarily would be rare and not common. Moreover this condition of necessity would have to arise before and not after the death of the embryo and of detachment of the chorionic vesicle. As in one of the cases of Hiess (1914) such a specimen also should contain blood vessels for as emphasized also by Ballantyne (1913) the hydatiform villus not merely is an oedematous villus.

That any one at all familiar with hydatiform degeneration in its earlier as well as its later forms could upon gross and microscopic examination confuse such a condition with maceration changes in a fairly well preserved specimen in any but its very earliest or very latest stages does not seem possible to me. Normal villi contain capillaries not to mention other things characteristic of them. Hydatiform villi on the contrary do not contain them or only very rarely so and in early stages. When a villus becomes hydatiform that is when liquefaction of the stroma occurs this liquefaction appears in more or less restricted portions of the villus thus giving rise to the long fusiform and later spherical vesicles so characteristic of the

hydatiform mole. But when a villus becomes macerated the change is general and usually also is noticeable in the embryo and in the chorionic membrane itself or at least within its epithelium. The latter usually is lifted from the stroma here and there the caliber of the entire villus is increased and the capillaries and the stroma also show maceration changes as the villus becomes more translucent. This increase in caliber of the entire villus is not due merely to local liquefaction of the stroma but to the pseudo oedema occurring under such conditions in a villus of normal structure and form. In hydatiform moles on the contrary the epithelium not only is firmly attached but usually is hyperactive. The changes characteristic of hydatiform degeneration may and often do appear in the villi while they still are implanted and do not arise only after the chorionic vesicles are detached. This does not imply however that the villi of a detached hydatiform mole cannot also undergo maceration changes. They of course frequently do so and it is in such cases as these that differentiation may be difficult or impossible especially if differentiation is to be made from an examination of ill preserved fragments only. The same thing is true also of the villi in the early stages of hydatiform degeneration and maceration when the latter masks the former. The difficulty in diagnosis would be still greater in case of whole chorionic vesicles which are almost completely dissolved leaving only a shadow picture formed by coagulum without nuclei which nevertheless may retain the form of the chorionic vesicle and of the individual villi almost perfectly. Such cases as these it long may be impossible to differentiate but they form only a relatively small proportion of the whole. The many cases both of uterine and of tubal chorionic vesicles which still were implanted and showed exceedingly fine instances of hydatiform degeneration as well as the many splendid examples of groups of villi detached from the chorionic vesicle which still were implanted in the tube or in the decidua and which were equally good examples of hydatiform degeneration leave no room for doubt as to the frequency of occurrence of this condi-

tion even after due allowance for the occurrence of doubtful cases is made

Werth further concluded that not one of the seven cases of chorio epithelioma regarded as having arisen from tubal pregnancies recorded before 1904 was sufficiently authenticated. Nevertheless by 1908 Veit felt justified in saying that a considerable number of cases of chorio epithelioma arising from tubal pregnancies had been described. Veit added that Risel (1905) gathered 11 cases from the literature and that a second case had been reported since Risel's paper.

Since my interest in this subject is largely incidental I have not taken the trouble to gather from the literature cases of chorio epithelioma alleged to have arisen from tubal pregnancies which may have been reported since Veit wrote. Moreover I could not presume to judge these cases critically. Hence I will accept the fact that chorio epithelioma arising from tubal pregnancy is regarded as established by a number of investigators and if the present conception regarding the relation of chorio epithelioma to hydatiform mole is justified then the occurrence of hydatiform degeneration in tubal pregnancy must follow on *a priori* grounds alone. Moreover whatever the causes of hydatiform degeneration may be one probably is safe in assuming that the condition is not restricted to the uterus and when I noticed that hydatiform degeneration was so very common in young uterine abortuses the surmise that it might be still more common in cases of tubal pregnancy seemed justified. Since over 100 specimens of tubal pregnancies from the Mall collection were included in the survey originally planned by Mall a study of these specimens formed an excellent opportunity for observations on this subject.

That the case of tubal pregnancy of Otto with its pathetic history really was one of hydatiform mole one cannot doubt in view of the careful description of the whole case, its clinical history, necropsy and the histologic examination. This case is interesting also because the degeneration was in its early stages the hydatids being only as large as a pinhead and the embryo still being present.

Moreover from Otto's description it is very likely that the specimen contained Hofbauer cells which are discussed elsewhere (Meyer 1919).

The history of the case observed by Wenzel in 1855 and reported in 1893 is equally complete and equally pathetic as can be surmised by all familiar with the history of tubal pregnancy. In this case the mole was as large as a hen's egg, the hydatids varied in size from 1 dot to a bird cherry wild (?) cherry and the degeneration was universal although the menstrual age of this specimen was given as only 51 days. It is significant that Wenzel expresses surprise that even excellent handbooks of the day had nothing to say about hydatiform mole in cases of tubal pregnancy except perhaps to refer to the case of Otto. Nor does the case of Wenzel seem to be the first one observed or that of Otto the first one reported for Storch (1878) in truly epochal though largely ignored observations on hydatiform mole states that Henning (1876) stated that 2 cases of moles in the tube were reported by Blasius (very likely E. Blasius 1802-75). Since Storch wrote on hydatiform mole it is implied that Blasius saw such and not another type of mole and since hydatiform mole is such a striking condition and has evoked much more interest than the other forms an observation regarding it in the tubes well might travel down the decades especially since until recently the occurrence of hydatiform degeneration in the tubes was regarded as extremely rare. This is indicated also by the fact that Menu (1899) still referred to the case of Otto as a curiosity.

Pazzi (1908) states that 2 cases of extra uterine moles have been described each by Henning (1872), Favell (1893), Donald (1902) and one case each by Otto, Freund, Theilhaber, Maret, Matwjcw (Matwejew?) and Syow, Bland Sutton and one case of ovarian mole by Wenzel (1893). Wilkinson is said to have described a case of rupture of the tube with reduction of the mole to the size of a cherry and Lob (190 ) a case of molar tubal pregnancy without cessation of menstruation. Since I am quoting Pazzi essentially verbatim it is evident that he did not read the

literature critically or discriminate between ordinary and hydatiform mole but was misled by the old inclusive usage of the term mole and molar still current at the present day.

Krueger (1903) also reported a case of hydatiform mole with a cyst a large as a walnut. The pedicle of the cyst was 4 centimeters long and attached to the amnion near the cord. Krueger spoke of this as a placental cyst but regarded it as a hydatiform mole like structure which microscopically was limited to a single villus. If this were the only evidence presented by Krueger one well might question the nature of the cyst but he added that microscopically the beginnings of hydatiform formations could be recognized on other villi also. Hence it would seem that Krueger's cases must be added to the authenticated ones of hydatiform degeneration in the tube.

So far as I am able to learn we have then in the literature report of 5 cases of hydatiform mole occurring in the tube. Of these 5 cases are not well authenticated however. The 3 cases consist of the case of Blasius or Hennig that of Ottel von Recklinghausen and Freund of Wenzel of Croom that of Matwejew and Sykow and that of Krueger. A critical reading of Hennig's (1876) book on disease of the tubes and tubal pregnancy makes it quite clear however that Hennig merely said that Blasius discovered tubal mole and that he observed and Behm's case of abortion of tubal mole. From the context it is also very clear that Hennig was not discussing hydatiform moles although it is not possible to say whether he meant that he himself or Blasius observed cases. I should judge that the latter is the idea it was meant to convey. To the 6 remaining cases I make bold to add that of Maxwell (1910). In reading Maxwell's description one cannot help but feel that he himself regarded the case as one of hydatiform mole but that he deferred to the opinion of the committee. This is also suggested by the title of his article. The illustration which accompanies Maxwell's article is very suggestive and his description so characteristic of hydatiform mole that it

seems very probable indeed that the specimen really was such. Maxwell states for example that sections of the villi embedded in the wall of the tube have the typical structureless bloated appearance of such pathological villi and though there is no central cavitation in the villi their structure associated with the active proliferation of the Langhans layer suggests that one is looking at a stage just short of vesicle formation. Moreover as I am about to show hydatiform mole is so very common both in tubal pregnancies and in uterine abortions that the likelihood that Maxwell's case actually was one of hydatiform mole is increased still further. This to be sure merely is a presumption and a more complete description or an examination of the specimen itself only could decide the matter.

In connection with what has been said it is interesting that Maxwell also emphasized that epiblastic activity is increased in all abnormal sites of implantation and any one interested in the problems of tubal pregnancy and acquainted with Mall's (1915) findings will be struck by Maxwell's statement that microscopic examination of many cases of tubal gestation lend no weight to the view that chronic inflammation of the tubes is at all a common causal factor. Nor can I refrain in this connection from quoting the strangely uncontradicted opinion of Doran expressed in the discussion of Maxwell's case that tubal gestation probably represents some general deterioration in the generative power among civilized women.

To the 27 cases contained in the literature I wish to add 48 found among the first 1187 accessions from the Mall collection. Nor is it necessary to stop with the case for the rest of this collection contains other not here included. It is merely a matter of recognizing the specimen by a routine examination and since the paper has been written a number of specimens have been recognized among the duly accessions of tube which we receive through the unceasing efforts and the scientific interest of practitioners from all parts of the nation.

In addition to over 100 specimen of hydatiform degeneration reported elsewhere



Fig. 1. Cross section of a hydatiform tube in tubal pregnancy. No. 825 case of Cecil L. Vest. No embryo.

I also have seen more than a dozen fine specimens in large sections of uterine implantation sites and also a number of entire specimens still embedded in the pregnant uteri and tubes. Indeed how many cases of hydatiform degeneration one can find in abortuses in tubal or hysterectomy specimens even will depend very much upon the care with which the examination is made for the condition undoubtedly is extremely common and not rare as heretofore supposed.

Although the alleged menstrual age of these 48 conceptuses ranged approximately from 6 to 218 days most of them were young empty chorionic vesicles or mere remnants of such. Portions of quite a number still were implanted within the tube however and among these were two unusually fine specimens from a twin pregnancy in the tube donated by my friend Cecil L. Vest of Baltimore. Since the question of superfetation has been raised also in connection with twin tubal pregnancies I hasten to add that such a phenomenon even if it ever occurs which seems exceedingly doubtful can be excluded absolutely in this case. Both chorionic vesicles were approximately of the same size and lay in practically the same cross section of the tube the surfaces of contact being flattened.

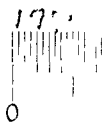
Before proceeding with the statistical findings I may say that the abortuses in the Mall collection which are regarded as pathologic are grouped (1) as villi only, (2) as empty or partial chorionic vesicles, (3) as chorionic vesicles containing some or all of



Fig. 2. Hydatiform villi from same case as in Fig. 1.

the amnion and (4) specimens containing a nodular or (5) cylindrical embryo or (6) a stunted and (7) macerated and mummified foetus. Any one interested in this classification will find it discussed and exemplified in an article by Mall (1917) and also in a forthcoming publication by Mall and Meyer to be issued by the Carnegie Institution of Washington.

There were 34 tubes containing villi only and in 13 of these hydatiform degeneration probably was present. In 8 specimens its presence was undoubtedly but in 5 it was probable only. I realize that this margin of probability is exceedingly large but if it is recalled that often only a few degenerate villi embedded in clot were contained in the cross sections of many of the tubes and that only a few sections and not of course a complete series of each tube were examined this is easily understood. Had the entire tubes been examined or if more villi had been present and if those present had been better preserved the difficulty would have been obviated almost wholly. However it is idle to set forth these things because such conditions never will obtain and if it be remembered that a large series of specimens necessarily supplement each other the margin of



1 4 1 ml f m m h k m k m

1 4 1 ml f m m h k m k m

probability become greatly reduced. Moreover the change in the villi often are so typical that they are unmistakable even if only a few villi are present. Besides examination in complete cross section and obliquely would increase and decrease the number found. In some of the doubtful cases the existence of hydatiform degeneration became probable only upon comparison with the many uterine specimens previously examined.

The evidence offered by the 4 specimens in the second group which is composed of empty chorionic vesicle or parts thereof is very conclusive for the cut portion of most of the tubes contained considerable portions or even sections of whole chorionic vesicle (sometimes quite free from clot). Some of the tubes were implanted almost perfectly in the wall of the tube and although many of them were folded extremely and were collapsed more or less small areas of several nevertheless were implanted undisturbed within the tube. The villi in some of these implanted specimens were so characteristic and the whole picture was so exquisite that these specimens rightly belong among the very finest instances of hydatiform degeneration found so far. Many of the tubal specimens were remarkable indeed and this is true in particular of the case of twin pregnancies received from Dr. Vetter. In this specimen the two chorionic vesicles the intervillous spaces of which were devoid of blood lay in almost the same trans-

verse diameter of the tube and hence had flattened the latter considerably. Both were implanted quite well over the entire area of contact which included the whole perimeter of the tube. The chorionic vesicles were flattened at the region of mutual contact which divided the tube somewhat unequally as shown in Figure 1. Although the embryo and the amnion long had disintegrated completely and although the chorionic membrane itself is thus covered by degenerate epithelium and is disintegrating the epithelium of the villi not only is well preserved but is accompanied by large masses of trophoblast and considerable syncytium as shown in Figure 2. Syncytial buds are found on the chorionic membrane also. The tubal mucosa is largely and the tubal wall partly destroyed by the invading trophoblast. Only a few small vestiges of the wall of the villous vessel remain and the stroma of all of the villi has undergone changes characteristic of hydatiform degeneration. One villus also contains an epithelial cyst resulting from epithelial invagination with subsequent isolation of the distal extremity a process to be referred to elsewhere (Meyer 1919) in connection with uterine specimens. Since most of the villi of this and similar specimens still are implanted in the tube there no longer can be any question as to the time in which hydatiform change in the stroma of the villi are inaugurated. As illustrated in previous instance in which isolated and small groups of villi still were implanted the advent of degeneration of the stroma occurs in part at least before the villus is detached. It is not merely a maceration change.

Another very interesting specimen of tubal implantation is No 1771 received from H M N Wynne of the Johns Hopkins Hospital and shown in Figure 3. The menstrual age of this specimen is 49 days but its anatomic age is based on length according to Dr Streeter's curve (unpublished) is 37 days thus showing a discrepancy between the menstrual and anatomic ages of 12 days. The embryonic length is only 1.5 although with a menstrual age of 49 days it should be at least 18 millimeters. Upon examination Dr Streeter found the chorionic vesicle to contain a good deal of magma, some of which still was adherent to the embryo as Figure 4 shows. As has been repeatedly emphasized in the literature the presence of this conglobulum in itself probably indicates that the embryo died some time prepartum.

The wall of the tube was quite thin as Figure 5 shows but the implantation is fairly well preserved around the whole perimeter of the specimen. The mucosa is destroyed throughout the greater extent of the section but the trophoblast is abundant except in one rather degenerate and hemorrhagic area. The chorionic membrane is thin but contains some vessels distended with blood. The stroma of many of the villi also contains vessels filled with blood but the vessels in many villi are very evidently in degeneration. The syncytium is scanty and many of the villi are very plainly hydatiform as Figure 6 shows.

A second exceptionally fine specimen of tubal hydatiform mole is No 052 donated by N M Davis of Washington. Figure 7 shows a portion of the tube containing the hydatiform mole, some hydatiform villi of which protrude through an incision in the wall of the tube. The whole opening is filled with typical hydatiform villi which are perfectly evident to the unaided eye and very evident under an enlargement of 4 diameters. They present an extremely fine picture when seen with the binocular under a magnification of 10 to 20 diameters. Examination under a higher magnification shows that the preservation of the specimen is unusually good and that all the villi are markedly hydatiform. Trophoblastic proliferation is so marked that

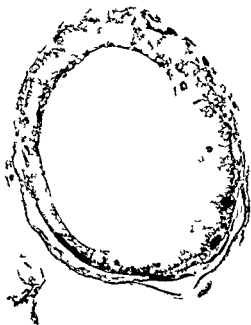
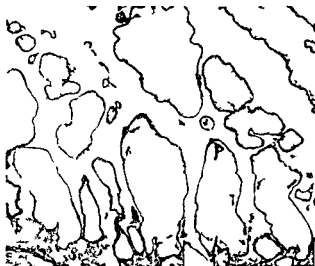


FIG. 3. Cross section of tube

in some places it gives the appearance of decidua formation. Relatively little syncytium is present but the trophoblast invades the muscularis in many places and a good deal of conglobulum is present most of it apparently having arisen from degeneration changes in the stroma of the mucosa and from similar changes in the trophoblast and the muscularis. The latter is moderately invaded by round cells. No remnant of the wall of the chorionic vesicle or of the amnion or embryo could be detected in the sections examined both evidently having been absorbed completely and only some of the villi remain behind. Or the chorionic vesicle may have been aborted and these villi left implanted within the tube.

Some exceedingly fine hydatiform villous trees were found among the specimens in this group. Scaffolding or frameworks formed by proliferating syncytium arising from the epithelium of the chorionic membrane also were seen. Since the syncytial buds also were found far out on proliferations of trophoblast which capped the villi and also in the center of trophoblastic nodules the origin of the syncytium from the Langhans layer would seem to be again and exceptionally well confirmed here. In some cases a detached





I c H d t t m l l f m t h m

hydritiform villus was fastened by opposite extremities to two portions of the tube wall. It is well to remember however that these attachments may have been gained and indeed they probably were gained before the separation of the particular villus from the chorionic vesicle.

Of the 34 cases remaining in this group of chorionic vesicles without amnion 14 or 50 per cent showed the presence of undoubted hydritiform degeneration and in one additional case its existence was doubtful.

Since only a few specimens are contained in each of the last five groups I shall treat them as one. Among the 30 specimens in the e groups 16 or 53 per cent showed the presence of hydritiform degeneration. From this percentage it is evident that the incidence of hydritiform degeneration among tubal specimens seems to increase slightly with advancing age of the conceptus rather than decrease as was emphasized in connection with the uterine specimens considered elsewhere (Meyer 1918). This probably can be attributed to the fact that the specimens in the first group are composed of villi only and that many of the empty chorionic vesicles in group 2 were detached from the wall of the tube by hemorrhage before hydritiform degeneration had developed sufficiently to enable me to recognize it. Moreover it must be remembered that all

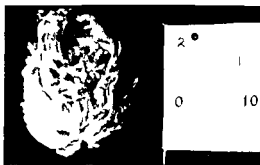


Fig 7 I d l t f p g t t b h  
hyd t f m l l p tr u l f m t h N M D f m t h N

tubal specimens no matter in what group they are classified are in fact young specimens and since the falling in the later group succeeded in maintaining a foothold in spite of repeated hemorrhages a larger number of them might rightly be expected to show the presence of a hydritiform change.

The incidence of hydritiform degeneration among 104 tubal pregnancies classed as pathologic 148 or 46.1 per cent of the whole. This is a somewhat higher incidence than was obtained in the 348 uterine abortions classed as pathologic. This may be due partly or wholly even to the greater incidence of young specimens in the tubal series. That the tubal specimens undoubtedly were younger follows from common knowledge regarding tubal pregnancies but it also is shown by the average menstrual ages which were 43.4 days in 25 tubal as compared with 66.6 days in 51 uterine specimen. Moreover 3 of the 48 tubal specimens of hydritiform degeneration or 66.25 per cent fall into the first two groups of the pathologic thus again showing that the majority are small young specimens.

Although the incidence of hydritiform degeneration among the pathologic tubal specimens is but slightly higher than that among the pathologic uterine specimens the incidence of hydritiform degeneration in all tubal specimens both the normal and pathologic is twice as high as that among the same classes of uterine specimens. This difference can be explained only partly by the fact that a larger proportion of the tubal specimens are young and pathologic. The pathologic tubal

specimens were found to form 6.9 per cent of 133 normal and pathologic tubal specimens found among the first 1187 accessions but the pathologic uterine specimens form only 3.6 per cent of the normal and pathologic uterine groups among the first 1187 accessions. Hence the real question remains for the incidence of hydatiform degeneration among the specimens classed as pathologic was essentially the same in tube and uterus. The increased incidence of hydatiform degeneration of 100 per cent in all tubal as compared with all uterine specimens may be due to the less favorable nidus found in the tube. If so it throws a very significant light upon the probable cause of hydatiform degeneration which would seem to lie in the conditions surrounding implantation and early development rather than in the ovum or spermatozoa themselves.

Whether hydatiform degeneration in the tube also is relatively more common near the menopause as was found to be the case in uterine pregnancies I do not know for I have not been able to obtain data on the relative frequency of tubal pregnancy in the different decades of the reproductive life of women. However since by far the greater number of uterine pregnancies occur early in this period it probably would be safe to assume that most tubal pregnancies also occur during this time. Consequently it might well follow that the ratio of tubal hydatiform degeneration to the number of tubal pregnancies occurring in the *later* actually might be greater than in the *earlier* decades.

The conclusion reached in a study of uterine specimens that hydatiform degeneration is *absolutely* less not more frequent near the menopause is confirmed also by the study of the tubal specimens. The average age of 60 women in the tubal series was 33.9 years as opposed to an average of 31 years obtained from 36 women in the uterine group. This age difference offers a tempting opportunity for generalization and did the statistics include thousands of case one might be willing to say that it points to a progressive change as cause which begins in the uterus and finally reaches the tubes. But strangely

enough the average number of years of married life of 15 women in the tubal series is exactly the same as that of 9 women in the uterine series or 71 years. This fact at once guards against a venturesome hypothesis for it allows a no longer period for the supposed ascending change to reach the tubes than the uterus.

Eight of the 60 women in the tubal series had borne one child, four had borne two and three more than two, thus again more than confirming the statistical findings in the uterine series which show that 9 of 33 women had borne once and 18 twice. The parallelism between these statistics is striking indeed especially if the numbers involved be considered. Fourteen of the 36 women or 60.8 per cent in the tubal series had aborted but once as compared to 19 out of 44 or 46.3 per cent in the uterine series, facts which again point to the middle rather than to the end of the reproductive life of these women.

Since the structural changes in hydatiform degeneration will be considered more fully in the Mall Memorial Volume I shall not repeat the description here. Suffice it to say that since I directed my attention especially to hydatiform degeneration I have been able to recognize its presence repeatedly at sight in relatively young chorionic vesicles—one centimeter large—not only from uterine but also from tubal pregnancies. This is true of course especially in the former for the chorionic vesicles of these often are quite characteristic and when inspection with the unaided eye or with a reading glass under a magnification of two diameters fails to reveal the true nature of the specimen examination with a binocular under a magnification of ten or twenty diameters often does so at sight.

The observations reported here should not in themselves be permitted to change the present opinion regarding the malignancy of uterine hydatiform mole. That opinion is based on specimens which survive until the later months of pregnancy and the tendency to malignancy in such may be and undoubtedly is a totally different one from that present in the overwhelming majority of specimens which are aborted in the early



# IMMEDIATE SURGICAL MANAGEMENT OF ACUTE APPENDICITIS IN MILITARY HOSPITALS

SUGGESTING A POSSIBLE RELATIONSHIP BETWEEN THE ONSET OF THIS CONDITION IN THOSE CASES WITH A HISTORY OF PREVIOUS ATTACKS AND THE PRESENT METHOD OF ADMINISTERING THE TRIPLE TYPHOID VACCINE

By HUGH MCKENNA M.D. I.A.C.S. CHICAGO

Pres d t f St ff St J ph Hospital f m ly L t na t C l l Medical C mp U S A d Ch f f th 1 S rv  
C mp P k B se H p t l

ANYONE who has listened to and practised the lessons taught by the late John B. Murphy in the surgical management of acute appendicitis cannot help but be profoundly impressed with the accuracy of his teaching especially where opportunity affords an extensive observation over acute abdominal lesions.

This opportunity has come to us in the surgical management of 48 cases of appendicitis operated on at the Camp Pike Base Hospital. The following pathological conditions of the appendix were found:

|                         |     |
|-------------------------|-----|
| Acute cases             | 143 |
| a Not ruptured          | 12  |
| b Ruptured              | 15  |
| c Necrotic              | 6   |
| Subacute cases          | 36  |
| Chronic case            | 65  |
| Appendicitis obliterans | 4   |
|                         | 248 |

The feature of paramount importance in the early recognition of acute appendicitis is brought out by a carefully and intelligently interrogated history. Conviction in the necessity of instituting surgical treatment within the first few hours after the onset of acute appendicitis prompts me to urge the taking of a more methodical history and the institution routinely of a searching examination in every abdominal condition in a patient seeking advice from a physician.

I am of the opinion that medical men do not frequently get out of the patient's history the points of real diagnostic value. Under a controlled system of examination and history taking such as is required in this hospital it is interesting to note how quickly and accurately young medical officers have been trained to recognize acute lesions of the abdomen.

I wish to digress at this stage of the discussion of the history of this disease to give an account of what has been done at this hospital to bring these cases under early surgical observation.

In the latter part of November after an experience in handling a number of patients suffering with ruptured appendicitis and peritonitis because of delay in being sent to the Base Hospital I asked permission of the Commanding Officer of the Hospital and the Division Surgeon to take this subject up at the weekly lyceum meeting with the regimental surgeons. In this conference the mortality statistics were brought out where operation followed (a) in the first 12 hours (b) 36 hours (c) 72 hours etc. etc. Vital importance was directed to the fact that where operation was performed for this disease in the first twelve hours after the onset the mortality should be practically nil in the hands of a competent surgeon and in a hospital where modern surgical technique has been instituted.

The method of diagnosis was gone over in the detailed manner about to be given here.

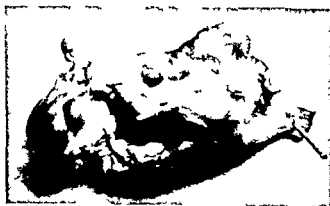


Fig. 1. Photograph of Lieut. D. J. Penhix



1. The appendix. 2. The appendix. 3. The appendix. 4. The appendix. 5. The appendix. 6. The appendix. 7. The appendix. 8. The appendix. 9. The appendix. 10. The appendix.

after in this paper. Much importance was attached to the fact that all cases suffering with pain in the abdomen should be sent to the hospital immediately even though the regimental surgeon did not make the diagnosis of appendicitis.

Since it is imperative that these medical officers not only keep the cardinal symptoms of acute appendicitis clearly before them but also keep in mind their sequential order of occurrence I am taking the liberty of reiterating them here.

1. Pain cramp like in character the patient stating that the pain is in his stomach and not in the region of his appendix. The initial pain complained of by the patient is in the pit of his stomach finally becomes general and later is confined to the McBurney region. (It is very strange to me that so many medical men miss the significance of noting that the pain comes *first* as many will state that the patient was sick at his stomach when upon a close interrogation the patient clearly state that the nausea came on later.) Muscular rigidity and local tenderness shows a marked contrast when compared with the opposite side.

Nausea or vomiting practically always follows and never precedes the abdominal pain. Since the nausea or vomiting may not

come on for several hours to eighteen hours after the initial attack the patient may have been operated upon before this symptom manifests itself. The nausea and vomiting as a rule is not repeated.

3. The increase in temperature is not of great significance because it may or may not be present though a slight increase at least is usually always present in these cases.

4. Leucocytosis when it is positive is a valuable symptom and a differential count in order to show an increase of the polymorphonuclear leucocytes should always be made.

I might take up much more time reviewing other symptoms or points of differential diagnosis but will content myself with the review of the important cardinal symptoms that every medical man should keep constantly before him when he examines an acute abdominal condition.

Much interest has been manifested at this camp over the occurrence of acute appendicitis characterized by some unusual symptoms following inoculations of the triple typhoid vaccine. The clinical symptoms would seem to be milder than those observed in civil practice among patients who have not been immunized against typhoid and paratyphoid fever. The blood findings have

been of special interest since even in many of the well-established inflammatory conditions of the appendix a leucocytosis apparently was not present. The blood findings were found so uniformly to contain a low white cell count in the presence of suppurative conditions of the appendix that it was decided to examine the blood of a few hundred soldiers in good health who had previously received the triple typhoid vaccine.

I have asked the Director of our Laboratory to make these examinations and through the courtesy of Lieutenant Solomon F. Hoge I am able to submit the following report:

This preliminary report which follows includes the white blood count of two hundred persons of the Base Hospital. The first hundred was taken of the men on duty in the hospital and were considered perfectly healthy. The second hundred was taken from men who had been in the hospital for one or more ailments of a trivial character and just before a discharge from the hospital.

From the general condition of these patients it seems that their leucocytic curves should stand about at its normal. These persons were chosen in an attempt to establish a measure of influence that the triple typhoid vaccine could show on the leucocyte curve of the individual and at the same time, if possible, to give some clue as to the question of why so many cases of appendicitis acute and subacute do not show a higher leucocyte count.

The patients coming into the hospital to the Surgical Service for observation and for operation as the case may be have all had at some time or other their triple typhoid vaccine. This course of immunization seems to be the one common factor which could possibly cause a transient or semi-permanent alteration in the leucocyte count. Not being able to find definite statistics in the literature at hand covering this point it seems well to hold this uppermost in the course of our study. The technique employed was similar in every respect and done by the same persons as those who made the count for the operative cases. Each man was asked the time of his vaccination, whether one or more courses of vaccination and the reaction that followed. Each person was questioned and examined for the possible condition that would cause an increase of leucocytes at the time of the count. The relationship to meals, the factor of excitement, depression, the presence and absence of malarial history were all considered and where indicating a possible influence upon the leucocyte count the patient was excused.

An inspection of the findings shows that the total leucocyte count of the first hundred men is 819,000, making an average of 8,198. The total months of the first hundred patients were 609 from the time

of vaccination until the blood count. The average number of months was 6.09. The second hundred show a total count of 1,900 with an average count of 7,200. The total months from the time of vaccination were 533 with an average of 5.33. The chief differences in the comparison of those with a count between the various thousands as shown by the table shows in the first hundred 4 between the counts of four and five thousand while in the second hundred the number is doubled. The first hundred of the series showed 7 between five and six thousand while the second hundred of the series shows 18 between five and six thousand otherwise the hundreds are similar with the exception that the second hundred of a series shows 20 with a count of over 9000 while the first hundred of the series shows 35 with a count of over 9000.

Summing up the two hundreds we find that the greatest number (43) is found between six and seven thousand. The next nearest number (41) is between seven and eight thousand. Adding these two we find 84 or a percentage of 4 between six and eight thousand. The sum of those less than 1,000 is 80 which gives us a percentage of 40 with a leucocyte count less than 7000.

A review of the blood findings submitted shows that 40 per cent of the bloods examined gave a white cell count of 7000 or under. In the event of these cases represented in this 40 per cent 100 those with a white cell count of 7000 or under contracting an inflammatory condition such as an acute appendicitis it can be readily seen that a white blood count of 9 to 10 thousand would show a relative leucocytosis.

My observation over these cases leads me to believe that the foregoing is an explanation of a large number of the low blood findings in the cases of acute appendicitis developed at this camp.

Respecting a possible relationship between the inoculation of the triple typhoid vaccine and the onset of attacks of acute appendicitis I have the following facts to submit. An examination and history (which is still going on) have been made of over fifty soldiers suffering with various inflammatory conditions of pyogenic origin. The following interrogations were made:

a. What was the date of the triple typhoid vaccination?

b. Did you have fever and malaise after the inoculation and if so was it sufficient to keep you in quarters or in bed?

c Have you had bad teeth bad tonsils and does examination at this time show infections in the mouth or throat?

d Have you had malaria?

Sufficient data have been collected to show that in a majority of cases a marked reaction follows the inoculation with the triple typhoid vaccine. Our examinations have covered a sufficient number of cases to say that it would appear that the reaction following the injection of the triple vaccine is a predisposing factor in the causation of an attack of appendicitis particularly in those cases with a previous history of appendicitis. Whether this gives expression by the formation of an embolism from the vaccine itself or by causing the passage of an embolism from a point of focal infection into the end arteries of the appendix or is responsible for a lymphadenitis that stirs up a latent infection in the lymph follicles of the appendix cannot be stated definitely. However the following evidence is suggestive of some pathological change in the lymphoid tissue of the body. An examination of many of the soldiers giving severe reaction following the triple typhoid inoculations in addition to clinical manifestations involving the heart and kidneys shows an acute adenopathy in various parts of their anatomy and a fair percentage manifests marked tenderness in the McBurney region.

It is thought that the lymph follicles of the appendix may become a *locus minoris resistencie* and therefore undergo an early inflammatory change in those soldiers suffering with infections about the teeth and mouth when the infection is stirred up and thrown into the blood stream by the vaccine reaction.

These references to triple typhoid vaccine are in no way to be construed as being opposed to immunizing against typhoid or paratyphoid fever as an adjunct of seven months observation at intervals without a single case of either of these diseases is significant proof of how important a prophylactic measure really is. I am strongly of the opinion that the triple typhoid vaccine by repeated inoculations that the

much less the patient spared from much unnecessary suffering and possibly from some complications

We have operated upon a number of cases that were walking about in the wards and showing no signs of discomfort. In one case a soldier had been discharged with instructions to return to his barracks when a slight distention of the abdomen called for re-examination and one hour later an operation revealed a much distended suppurative appendix.

In the early organization of this hospital these patients as a rule had had their initial symptoms of appendicitis in the regimental infirmaries or barracks before entering the Base Hospital so that we had to depend upon the history given by the patient for a diagnosis rather than upon the findings at the time of entrance into the hospital. The symptoms have been so mild in many cases that it has been difficult to impress the patient with the necessity of an immediate operation so that in a number of instances cases have gone on to a rupture before the patient consented to an operation.

I am of the belief that however slight the symptoms manifest themselves at the time of the patient's entrance to the hospital the initial symptoms though they may be mild come in sequential order and should permit the ward surgeon to make an early diagnosis when these symptoms are properly interpreted at the onset of the disease. It is singular that with the great amount that has been done and written regarding the subject of acute appendicitis still so many medical men fail to grasp in their proper order the symptoms of this disease. The major uses reported in this paper at the time the patients were examined by me gave a history of the symptoms previously outlined in the paper and though these symptoms were not in the order I believe came according to the law in acute appendicitis. A study of the history of my patients led on I wish to especially call attention to the fact because I believe that the type of our doctrine is the basis of the error.

him Let me say that even after a very careful and painstaking examination it required considerable argument to persuade this officer that he was suffering with an acute appendicitis

Patient W J D First Lieutenant M C 312 Supply Train born in Wilkesbarre Pennsylvania age 31 has always been healthy never having suffered with any disease of consequence except a mild attack of malaria ten years ago He has never had typhoid and has always been free from constipation previous to this time He received his inoculations of triple typhoid vaccine some time previous to this attack On the morning of December 20 1917 owing to constipation the patient went to the dispensary where he was given two ounces of castor oil He noticed a little distress in his abdomen but nothing that he would describe as pain He took care of his regular duties on that day and on the two following days but remained constipated during this time for which condition he took a dose of epsom salts which gave him immediate relief On Sunday the 3rd the patient developed an abscess in the root of a tooth and came to the hospital where the dentist drained his tooth cavity He returned to his command and on the 24th he held sick call and inspected all barracks giving a full day's work He retired at the usual time that evening and on Christmas morning at two o'clock he noticed some discomfort and soreness in his abdomen which he attributed to a large steak he had eaten the evening before He threw the covers off and examined his side and thought he felt a mass in the region of his appendix He disabused his mind of the possibility of his having appendicitis since he had not had any appreciable pain nausea or vomiting and contented himself with the thought that what he actually felt was impacted feces However at this time he felt a least bit nauseated He immediately went to sleep and did not awaken until 7 o'clock when he arose dressed and took up his regular duties held sick call made out and sent in his sick report and went out for a walk and was preparing to go to the city but because of his experience during the night and not because of any distress or discomfort at this time he asked one of his medical officers who happened to be at his quarters to examine him This examination was made at 12 o'clock mid day The examiner was of the opinion that he could feel some induration and a mass in the abdomen and urged the patient to go to the hospital The patient decided to shave and change his clothing before doing so and after straightening up his work about his quarters packed his own suitcase and came to the hospital arriving at 4 00 p m carrying his suitcase and apparently feeling well

Examination at the hospital pulse 76 temperature 98.6 respiration normal blood examination 12000 white cells

Physical examination abdomen was perfectly soft on pressure over the McBurney's point some tenderness was elicited on deep pressure over this region an induration was perceptible to the palpating fingers

The patient was immediately sent to the operating room where upon opening the abdomen the cecum was found bound down by a recent exudate the appendix was located adherent to the omentum lying entirely within the true pelvis The intestines were carefully packed off with gauze and upon separating down to the appendix free white and creamy pus escaped By a very careful and painstaking blunt dissection with the gloved fingers the appendicular mass was brought up and tied off without in any way contaminating the surrounding viscera This pocket was carefully swabbed out with sponges moistened in 1 per cent lysol drainage was carried into the bottom of the cavity the abdomen closed and the patient placed in the Fowler position and given normal salt solution according to the Murphy plan The patient contracted pneumonia during convalescence and continued the abdominal drainage for several months but finally went on to complete recovery The pathological report of this case is given by Captain M L Morris

Appendix is 6 centimeters in length Diameter at widest part is barely 1 centimeter It is covered throughout its whole extent with a thick gray exudative membrane which is firmly adherent to surrounding parietal as well as visceral peritoneum The entire distal half of the organ is necrotic Rupture had taken place most likely at about the middle third of the distal half of the organ The mesentery is congested thickened and covered by a like grayish membrane

The right rectus border incision has been used entirely A point is made of the introduction of the laparotomy sponge immediately upon making a tiny nick through the peritoneum By pushing the sponge into the peritoneal cavity by means of a Mayo scissors one is enabled to keep the intestines and omentum out of the field — allowing a quick and safe manner to open the peritoneum and protect the viscera from trauma at the same time The appendix in the large percentage of cases should be picked up exposing only the cecum which procedure may be readily carried out by passing the exploring fingers into the abdomen along the inner side of the right abdominal wall allowing them to sweep inward over the external iliac vessels until the meso-appendix and cecum are grasped The appendix may be easily delivered unless held by adhesions or a recent exudate



Our experience in the management of suppurative appendicitis with rupture has taught us that except in a very small percentage of cases with advanced abscess formation where the wall is so formed that further manipulation would allow free pus to run into the free cavity the appendix can be taken out successfully and should be removed.

I have made this statement with some reluctance fearing that physicians may mis understand my position respecting acute appendicitis with rupture however it is made on the basis of past experience in not removing the appendix if rupture had occurred depending upon drainage alone then after recovery giving instructions to the patient to return for an operation in the event of subsequent trouble. We have found that the second operation is difficult owing to adhesions and far more serious than the ordinary operation of appendectomy. As a rule the patient is invalided for a much longer period owing to the length of time the remnant of the appendix acting as a foreign substance causes drainage to continue.

The unremoved appendix is much more apt to cause further inflammatory disturbance in the abdomen particularly abscess formation in dependent positions.

The ability of a surgeon to perform successfully an operation for the removal of a ruptured appendix depends upon the intelligent and painstaking methods used in the operation. With the field well packed off with gauze pads and a line of cleavage to the appendix discovered there is no reason why the surgeon may not gently remove such a necrotic appendix without in my estimation any additional risk to the life of the patient.

#### CONCLUSIONS

1. The chiefs of surgical services in all Base Hospitals should place before the regimental surgeons of the Division the importance of early recognition of acute ap

pendicitis in order that surgical intervention may be immediately instituted.

2. The administration of the triple typhoid vaccine in three doses produces a marked reaction one phase of which we believe comes in the form of a lymphadenitis which condition when produced in an individual suffering with a latent infection in the lymphoid tissue of the appendix would seem to predispose to an acute attack of appendicitis.

3. The administration of the triple typhoid vaccine in more but smaller doses would probably produce the same degree of immunity without causing so severe a reaction.

4. Reliance should not be placed upon a leucocyte count as a diagnostic symptom in acute appendicitis unless it is positive. This is particularly true in a large percentage of the soldiers operated on at this camp for this condition whose blood seems to have been affected by some agent causing a low white blood count to an extent that the normal white count of 9500 may represent in these cases a relative leucocytosis.

5. Whether the triple vaccine is responsible for the low white count or is a factor in predisposing to acute appendicitis cannot be stated definitely but the uniform clinical findings associated with these cases are very suggestive and a report now in progress upon the blood findings made within the first two months following the triple typhoid vaccination of the soldiers of the present draft now being inducted into service may show even a lower leucocyte curve than those that have been examined and who may have lost some of the effect of their vaccination since they represent a period of four to nine months after inoculation.

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## THE OPERATION OF OMENTOPEXY IN CIRRHOSIS OF THE LIVER

BY ELLSWORTH ELIOT JR. M.D. AND RALPH COLP M.D. NEW YORK

WHILE the literature contains many individual case reports of the so called Talma operation or omentopexy for cirrhosis of the liver and several excellent collections and reviews have been compiled by Greenough White Montprofit Bunge and Ladenburger a few observations made from the study of twenty three cases operated upon at the Presbyterian Hospital during the last seventeen years may be of interest especially from the viewpoint of factors influencing the prognosis and from the end results.

It will be remembered that Talma of Utrecht conceived the idea of his operation from the supposition that cirrhosis of the liver was caused by a mechanical factor that is he believed the smaller radicals of the portal vein system were partially obliterated by the deposition of newly formed tissue in the diseased liver with a resultant higher pressure in the portal vein and a corresponding effusion of fluid into the peritoneal cavity. Hence by establishing an aiding anastomosis the blood of the portal system might be partially diverted and shunted into the systemic circulation. The veins of the great omentum which drain indirectly into the vena portalis and those of the diaphragmatic surfaces of the liver and spleen which are brought to the exposed surface of the diaphragm in the Talma operation were therefore utilized as the means for bringing the portal into contact with the systemic through the internal mammary and deep epigastric veins.

This theory has met with much opposition. Hale White and Thomson asserted that the ascites in cirrhosis of the liver was due to a chronic peritonitis and perihepatitis for in the postmortem findings of ten cases which survived more than one tapping four had no cirrhosis whatsoever and six had a peritonitis the latter due possibly either to the tapping or to the obliteration of the diaphragmatic lymphatics.

Rolleston stated that when the pressure is highest in the portal vein the time when

hæmatemesis occurs ascites does not as a rule make its appearance also that in a cirrhosis of the liver existing for many years without the effusion of fluid ascites may develop suddenly. Moreover ligation of the portal vein in animals (perhaps also in humans Brewer having reported one such supposed case) does not result in ascites.

Hahn Nasse Neckst and Pawlow believed that the fluid in the abdominal cavity might be explained by the fact that less blood passing through the liver the percentage of toxins becomes therefore higher and consequently a lymphagogue action might be exerted. That the blood which had not passed through the liver did have a higher percentage of toxins was demonstrated by a series of experiments on dogs establishing an Eck's fistula (communication between the portal vein and the inferior vena cava) with depression asthenia clonic and tonic spasms and coma following the anastomosis.

Whether Talma's reason for his procedure is sound or whether other factors are instrumental is an open question. Thomson Dickenson and Webber respectively from post mortem examinations made upon operative cases found the peritoneal cavity to be the seat of universal adhesions. Possibly as suggested by Rolleston and Turner the vascular channels of these adhesions carry off enough blood thereby lessening the volume which passes through the liver and this organ is thus enabled to detoxify more satisfactorily. Their suggestion perhaps resulted in the practice of rubbing the liver with gauze at operation in order to produce vascular adhesions to the under surface of the diaphragm.

In 1889 at the suggestion of Talma Van der Menke made the first attempt at an omentopexy with a resulting death. In 1891 a patient of Schley died of peritonitis and although a case of Lens of Holland lived for six months he showed no improvement. To Morison in 1895 is really due the credit for performing the first successful operation the patient lived

for many years with marked improvement dying from an attempt to repair a ventral hernia which had developed at the site of the previous incision. Since then there have been many successes many failures and many changes have resulted in the operative technique and postoperative treatment.

Much has been written concerning the proper selection of cases. Drummond and Morrison suggested only those cases whose ascites was due to cirrhosis of the liver. Greenough has collected from the literature cases of an omentopexy performed for ascites with rather discouraging results in cases of renal disease tubercular peritonitis chronic peritonitis adherent pericardium malaria and syphilis.

Of 127 cases of cirrhosis of the liver admitted to the Presbyterian Hospital in the last seventeen years only 23 were chosen for operation. F. McLeney found that out of 50 cases of portal cirrhosis treated in the medical wards 10 were transferred for operation. As a rule only those patients were selected who appeared to have enough resistance and who had little or no evidence of nephritis or cardiovascular disease.

#### ETIOLOGICAL FACTORS OF THE CIRRHOSIS

Eighteen cases were undoubtedly due to excessive use of alcohol in cases syphilis was the cause in 1 the cause was unknown and in the ascites was associated with an enlarged liver secondary to cardiovascular disease. One of these last mentioned cases died of acute cardiac dilatation directly after operation. The other three years after operation is still alive and greatly improved almost equaling in the duration of the cure the case reported by Primrose of Canada of a cardiac who tapped at least once a week during a long period of time was relieved from further paracentesis for four years by an omentopexy. The following is a brief outline of the authors case.

M. B. age 34 nationality I. h. white female married (Preferred by Dr. Jeffrey.) The patient was admitted January 4, 1915 and discharged February 16, 1915. A diagnosis was made of cirrhosis of the liver with ascites and chronic cardiac valvular disease with auricular dilatation. The chief complaint was swelling of the abdomen. The family history was irrelevant. The patient had scarlet fever as a child rheumatic fever at 3 with cardiac injury and

joint swelling and mild recurrent attacks of rheumatic symptoms since. The menses have been regular. The patient has been married 2 years and has three children living and all. There had been a stillbirth three years ago. There was no history of alcoholism and syphilis as denied by name and symptom.

The onset of the abdominal swelling had been gradual appearing first about one and a half years ago and accompanied by swelling of the feet. The symptoms were worse at night. For the past year the patient has suffered from gaseous eructations nausea and vomiting. Orthopnea has been a constant symptom from the beginning of her illness. For three weeks before admission the patient was forced to take to her bed because of severe dyspnea.

Physical examination shows a poorly developed thin and slightly dyspnoeic woman. The abdomen is very large and there are definite signs of fluid and marked edema of the lower extremities. The heart is hyperphoric the apex in the sixth space 6 centimeters to the left of the midline sounds are irregular in force and frequency. The systolic murmur at apex is transmitted to axilla and there are rough systolic and diastolic murmurs over the base. After paracentesis the liver edge felt as a hard irregular nodular mass about one inch below the costal arch. The spleen is not palpable.

The urine is clear amber colored without albumin and with a specific gravity of 1.025. There are a few pus cells. Phthalein test color in ten minutes 43 per cent in 10 hours.

Blood count white blood corpuscles 5,400 per morphonuclears 7 per cent hemoglobin 80 per cent. The Wassermann is negative in both antigens. Blood pressure 132/7. Von Pirquet's test was slightly positive. Moro test negative.

The ascitic fluid showed a specific gravity of 1.00 it was cloudy yellow and showed a small amount of sediment. NaCl 717 Polymorphonuclears 0 per cent lymphocytes 90 per cent.

Electrocardiogram tracings show auricular fibrillation and ventricular extrasystole.

On January 10, 1915 the patient was tapped and 6,000 cubic centimeters of fluid obtained on January 17, 5,600 cubic centimeters on January 23, 7,000 cubic centimeters and on February 10, 1915, 9,000 cubic centimeters. On February 11, 1915 an omentopexy was done under novocaine. The liver was found to be large and rough with evidence of chronic passive congestion.

The patient was discharged as improved February 16, 1915 following an uneventful recovery.

Our follow-up notes state that on May 2, 1915 the patient feels well has no orthopnea but there are signs of fluid. On May 25, 1915 the patient was tapped and 6,000 cubic centimeters of fluid obtained. Notification of August 9, 1915 states that no tapping has been done for the past year. The patient works around the house and her appetite is good. November 9, 1915 the patient feels very well but a slightly dyspnoeic. There is little fluid in the abdomen. F. B.

ruary 1917 the patient feels very well December 1917 fluid has collected in the abdomen very slowly 11 000 cubic centimeters removed

#### AGE INCIDENCE

It may be doubted whether age is a factor of importance but it does appear that before the age of twenty and after the age of forty the death rate is higher There were 2 cases under twenty years of age and both died From the second to the fourth decade the mortality was 16 per cent from the fourth to the sixth 60 per cent and all cases that were more than sixty years succumbed to the operation

#### SYMPTOMS AND PHYSICAL FINDINGS

Ascites was the cardinal symptom for which the operation was performed This was present to a variable extent in the 23 cases Eleven had oedema of the lower extremities morning nausea was troublesome in 9 jaundice was present in 4 and hæmatemesis occurred in but 2 patients Of 14 cases noted in the physical examination as being poorly nourished and emaciated with the thin drawn face and the reddened nose with dilated venules 45 per cent succumbed to the operation Of 8 cases having definite cardiac disease 3 with auricular fibrillation 2 with myocarditis 3 with relative mitral insufficiency 70 per cent died In those cases where dilatation of the deep epigastric and internal mammary veins indicated the establishment of compensatory circulation 50 per cent died shortly after operation This may show that where the portal channels were so obstructed as to force hypertrophy of collaterals operative interference was of little value the functional liver tissue being inadequate for the demands

#### RAPIDITY OF THE ONSET OF SYMPTOMS

There is indeed an interesting relationship between the suddenness with which symptoms develop and the prognosis In 2 cases ascites developed within three months and both died of 4 cases where the ascites was of six months duration 3 died of 7 cases where the ascites developed over an extended period of one year or longer there was no mortality It is quite evident then that the slower the effusion into the peritoneal cavity which perhaps may be considered a gauge of the rapidity of the path

ological process the better the operative prognosis Whether the number of ante operative tappings which were always greater where the disease was rapid in onset are of any prognostic value may be gathered from the following tables 4 cases tapped 15 to 25 times mortality 75 per cent 5 cases tapped 6 to 10 times mortality 50 per cent 14 cases tapped 1 to 5 times mortality 30 per cent

#### ANÆSTHESIA AND THE TYPE OF OPERATION

As far as the anæsthesia is concerned some cases were operated upon under cocaine and novocaine and some under a general anæsthetic of gas and ether the former with a mortality of 29 per cent the latter with a death rate of 37 per cent While many authorities claim that the anæsthesia whether local or general has little or no effect it must not be forgotten that most cases of cirrhosis of the liver are due to alcohol and that in this group the risk of an anæsthesia is relatively great The same risk may be increased still further by an associated nephritis The operation with local anæsthesia is easily borne if the parietal peritoneum is carefully infiltrated and if no undue traction is made in drawing the greater omentum into the wound Further more a local anæsthesia diminishes the risk of postoperative pneumonia and largely eliminates postoperative nausea and vomiting and consequently the frequency of a subsequent ventral hernia although a rare complication

The operation itself as originally planned by Talma and carried out by Morison has undergone many subsequent modifications Morison and Drummond advocated an incision from the ensiform cartilage to the umbilicus through which the peritoneum was opened and a portion of the anterior surface of the great omentum sutured to the posterior surface of the parietal peritoneum The liver and spleen had been previously vigorously rubbed with gauze so as to promote and encourage vascular adhesions to the diaphragm This practice obviously was attended with much shock

Nareth modified this by bringing the omental tab in between the recti muscles and their fascia to a position directly beneath the surface of the skin

Schiassi of Bologna sutured the omentum to the posterior surface of the peritoneum and to the preperitoneal space sewing tightly the anterior sheaths of the recti in the midline so as to insure a firm closure.

Greenough in his collection states that the method of Talma and Morison used in 68 cases showed improvement in 41 per cent and a mortality of 3 per cent while the method of Schiassi used in 3 cases gave 43 per cent improvement and a mortality of 17 per cent.

The Mayos make an incision over the right side of the liver in line with the deep epigastric and internal mammary vessels so that a thorough exploration can be made. About 4 inches below a second incision is made through the rectus down to the posterior sheath. A tab of omentum is then drawn from the upper incision down into the pocket formed by the posterior sheath of the rectus and the muscle itself. This may be done on both sides and the intervening segment of the omentum sutured to the parietal peritoneum.

In the present series the type of operation prior to 1908 was that advocated by Morison. Subsequent to 1908 the method of Schiassi was adopted with slight modifications. Ordinarily a three inch incision is made in the midline about two inches below the ensiform cartilage. The fascia of the linea alba divided the recti retracted to either side and the posterior sheath and the peritoneum incised. The fluid remaining after a paracentesis twenty-four hours before operation is further aspirated by suction through a metal catheter. In withdrawing the omentum care is taken not to distort the position of the transverse colon. A vascular portion of the omentum is then sutured to the posterior surface of the parietal peritoneum with interrupted chromic catgut. Further the tongue of the omentum is sutured lightly to the posterior sheath of the rectus in the preperitoneal space and to the edge of the rectus muscle. Then the sutured sheath of the rectus is closed with interrupted chromic catgut and continuous silk is used to close the skin. After the sterile dressing a tight binder is applied and directions given that in case of vomiting the patient should receive manual support. The operation as a rule requires about thirty minutes.

In the early cases of omentopexy drainage of the peritoneum was employed. It was later omitted for several reasons. First the drainage tract might act as an entrance for infection and furthermore some patients drain enormous quantities of fluid which resulted fatally in one case in spite of saline given by hyperdermoclysis proctoclysis and intravenously. Where drainage is omitted some claim there is danger from the mechanical effects due to the reaccumulation of fluid after operation. But should this occur should the fluid become sufficient in amount to embarrass either the heart or respiration paracentesis may be employed at any time forty-eight hours after operation. One advantage claimed for drainage is that through the formation of adhesions the peritoneal cavity is partially obliterated and hence the space is restricted for the subsequent accumulation of fluid. Ito and Oni have shown that in dogs the peritoneal cavity might be obliterated by tamponade of the abdominal cavity for twenty-four hours yet it is very doubtful whether even partial obliteration occurs in man. In his collection of 54 cases Greenough states that drainage was instituted in twenty with a resultant mortality of 50 per cent while in the 34 cases where the drainage was omitted there was a death rate of 14 per cent. In the present series drainage was employed in 5 cases a mortality of 80 per cent resulting while in the 18 cases where it was not used there were seven deaths or 38 per cent. Practically all surgeons have agreed that drainage is unnecessary of no distinct advantage and certainly multiplies materially the operative risk.

#### APPEARANCE OF THE LIVER

The appearance of the liver at operation is usually either hypertrophic or atrophic. In the present series there were 5 cases of enlarged liver one of which died while of 15 cases of a small and shrunken liver 7 died after operation. In Greenough's summary there are 15 cases of an enlarged liver 3 of which died after operation and 9 or 60 per cent showed improvement and in 37 cases of an atrophic liver 11 or 29 per cent died after operation while 36 per cent were improved. White in his collection of 106 cases mentions

the pathology of the liver and derives the following statistics

Hypertrophic 24 cured 10 improved 6 unimproved 3 died 5

Atrophic 82 cured 38 improved 7 unimproved 10 died 27

#### POSTOPERATIVE COURSE

There were eight postoperative deaths in this series seven occurring within the first eight days and one on the seventeenth day after operation. Of these eight deaths six were due to a combination of cholera and uremia, one was due to a cardiac failure and one the result of a mesenteric thrombosis. A brief resume of the last mentioned case is herewith appended.

J. M. age 50 male married German fish dealer. The patient was admitted January 4, 1916, died February 8, 1916. Diagnosis cirrhosis of the liver. The family history is irrelevant. The patient is markedly alcoholic having taken large amounts of whiskey daily for the past ten years. Three weeks before admission he noticed a gradual swelling of the abdomen with a progressive feeling of great weakness and morning nausea with vomiting. There were no hemorrhages from the nose, mouth or rectum. Physical examination shows a markedly emaciated man slightly jaundiced, accentuated aortic second sound. There is marked ascites and general condition of arteriosclerosis. The urine is clear amber, specific gravity 1030, albumin faint trace, hyaline and granular casts. The blood count showed white blood corpuscles 6000, polymorphonuclears 90 per cent. The Wassermann is negative in both antigens.

January 26, 1916. Patient tapped and 2000 cubic centimeters withdrawn. February 9, 1916, 6000 cubic centimeters withdrawn. February 18, omentopexy was done under gas and ether—time 20 minutes. The liver was found to be small and nodular. February 3, temperature 103 and patient feels comfortable. The abdomen is soft slightly distended. February 6, temperature daily rectal 103. The wound is clean. Distention is but little relieved by colon irrigation. Paracentesis removed 5000 cubic centimeter of dark brown fluid. Analysis of the fluid showed protein 1 per cent, much pus, polymorphonuclear 68 per cent. February, the abdomen was soft except in the right lower quadrant and around to the flank where there is moderate rigidity. The patient breathes rapidly but the lungs are clear. There is slight nausea with vomiting of greenish fluid not fecal. February 28, the patient is very restless, irrational and cyanotic. The abdomen is soft. Death in coma.

Autopsy by R. A. Lambert. The liver weighs 1050 grams and is typically hobnail. There is throm-

bosis of the superior mesenteric vein just below the mouth of the splenic vein. Acute diffuse purulent peritonitis.

Of the 75 cases of postoperative death collected by White, 14 died of peritonitis, 12 of uremia, 10 of shock and cachexia, 5 of hematemesis and 2 of intestinal obstruction. It is interesting to note that two of our cases died from what was presumably acute hepatic insufficiency—the latter characterized by a complete group of nervous symptoms, marked that in one case a diagnosis of meningitis was made. It will be remembered that Morison reported a similar occurrence in a case where undue excitement and depression prevailed after operation. At that time this was thought due to the injurious effects of turning the stream of portal blood into the systemic circulation. It may indeed be doubted whether the anastomosis is effective in so brief a postoperative period. Specimens taken at the autopsies of these two cases and of one which died six weeks after operation showed no macroscopic signs of newly formed blood vessels. Unfortunately, microscopic sections were not made.

Herewith is given a summary of two cases which showed marked symptoms of nervous character after operation.

E. K. age 19 American schoolgirl single. Admitted January 18, 1915, died February 15, 1915. Diagnosis cirrhosis of the liver. The family history is irrelevant. At the age of five the patient had had measles and scarlet fever with no sequelae. The patient's menses were regular. Syphilis was denied and she made no use of alcohol. For the past six months the patient has noticed a gradual swelling of the abdomen with no other symptoms. She was tapped three times in the last two months before admission, the last tapping being five days before admission. Physical examination showed a very emaciated, poorly nourished girl with no other abnormalities except marked ascites. The urine was clear, amber color, specific gravity 1030, and was negative as to albumin and microscopic examination. The blood count showed 12,000 white blood corpuscles, polymorphonuclear 5 per cent. The Wassermann was negative in both antigens. Von Irtgen negative. Stools negative for parasites. Phthalin test showed color in ten minutes, 41 per cent in two hours.

February 1, 1915, omentopexy was done under gas and ether. The liver was found to be small, hard and of hobnail appearance. Nine thousand cubic centimeter of clear amber fluid were aspirated.

February 13, 1915. For past few days the patient

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# END-RESULTS

When it comes to the ultimate question of the actual benefit derived from the operation the criterion necessarily must be the relief of the symptom for which the operation was designed namely the diminution in the number of tapping and the final disappearance of the peritoneal fluid The seven cases of which we have postoperative records have the following

| CASE | A | T | I | T |
|------|---|---|---|---|
| 1    | m | h |   |   |
| 2    | m | h |   |   |
| 3    | m | h |   |   |
| 4    | m | h |   |   |
| 5    | m | h |   |   |
| 6    | m | h |   |   |
| 7    | m | h |   |   |
| 8    | m | h |   |   |
| 9    | m | h |   |   |
| 10   | m | h |   |   |
| 11   | m | h |   |   |
| 12   | m | h |   |   |
| 13   | m | h |   |   |
| 14   | m | h |   |   |
| 15   | m | h |   |   |
| 16   | m | h |   |   |

Therefore in 16 cases under observation from three months to three years after operation definite benefit has been derived Of the 8 fatal cases after the omentopexy 1 died at four months and 1 at nine months respectively with no benefit Five cases left the hospital as improved but all trace of them was lost Of the 7 previously cited recoveries ventral hernia at the site of incision was the sole complication observed

In reviewing his 16 cases Grey Turner reported 3 postoperative deaths within a few days 3 from pneumonia 1 from uremia and 1 from cholera Of the 11 who survived 5

died subsequently leaving 6 alive and well seven months to seven years after operation. This author believes that the operation proved successful where ascites was due not to toxæmia but to portal obstruction furthermore that this may be indicated when several tapplings had caused no material disturbance and patients with rapid emaciation slight jaundice and oedema of the extremities should not be considered as suitable risks. Lidenburger advises operation as soon as the case is diagnosed as ascites due to portal obstruction and when after the first tapping there is a recumulation of fluid. Welp and Montprofit are even more radical advising immediate operation. We have always believed it best to tap at least once and even more before the operation for occasionally a patient will go into absolute collapse following paracentesis and rarely after a tapping or two will the patient have a return of ascites.

At the French Surgical Congress in 1904 Professor Montprofit in an analysis of 224 cases collected from the literature deduced some interesting statistics as far as end results are concerned. Eighty four cases or 38 per cent died within the first month — some from postoperative shock 9 from peritonitis 7 from complications of the heart lungs and kidneys 30 from late causes of cirrhosis 8 from stomach complications 4 from renal disease. Eleven cases were not followed up and 25 cases were not improved. Twenty six cases were tapped at long intervals and complained less of bleeding. Seventy cases were therapeutic cures that is either the ascites had disappeared or the hæmorrhages were arrested.

Bunge in his collection of 73 cases states

|                     | Per Cent |
|---------------------|----------|
| 5 died in one month | 0.8      |
| 90 not improved     | 32.9     |
| 35 improved         | 12.4     |
| 91 cured of ascites | 33.0     |

White excluding from Bunge's statistics and Montprofit's table the doubtful and valueless case reports and cases other than those of cirrhosis collected 27 cases

|                            | Per Cent        |
|----------------------------|-----------------|
| Deaths 5                   | 33              |
| Failures 34                | 15              |
| Improved 29                | 13              |
| Cured 84                   | 37.3            |
|                            | Number of Cases |
| Cured for 6 mos. to 1 year | 7               |
| Cured from 1 to 2 years    | 7               |
| Cured from 2 to 3 years    | 1               |
| Cured for 3 years          | 5               |

#### SUMMARY

In regard to the prognosis probably the most favorable cases are those between the second and fourth decade fairly well nourished without severe nephritis without cardiac lesions without signs of compensatory circulation which have stood a few tapplings (not more than five) in which the disease has come on gradually and slowly — the symptoms extending over a year — where the liver was of the hypertrophic variety and for which an operation of omentopexy was performed of the Schriassi type without drainage preferably under local anaesthesia. That the operation is of benefit in carefully selected cases there can be no doubt.

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# DEPARTMENT OF TECHNIQUE

## INCOMPLETENCY OF THE URETEROVESICAL VALVLES NOT DUE TO OBSTRUCTION

B. THOMAS N. HEPBURN, M.D. IACSS HARVARD UNIVERSITY

**I**NCOMPLETENCY of ureterovesical valves is not the result of intravesical pressure quite as much as is far as is known by reported cases. Hagner in 1908 and again in 1911 reported 4 cases of refluxation of bladder fluid after urethral catheter in the ureter. He believed this phenomenon occurred only in chronic inflammation of the ureteral orifice and it produced by infiltration and cicatricial tissue formation in the ureter which caused a destruction of the valve like a ringement in the normal ureteral

orifice. Two of Hagner's cases were secondary to tuberculosis of the kidney, one case was secondary to bilateral renal calculus and one case was secondary to a previous prostatic obstruction for which a successful prostatectomy had been done. The last case in my opinion belongs to the more common group as being the result of intravesical pressure and therefore does not come completely within the scope of his inflammatory etiology theory.

Kretschmer and Greer in 1915 review the case reported before this time and add one of their own with a very good X-ray picture taken with collargol showing a dilated bladder in competent ureterovesical valve dilated and kinked ureter and dilated renal pelvis and calyces. They do not explain the etiology in their case but with the cystoscopic report of trabeculation of the bladder and the roentgenogram showing dilatation of the bladder the etiology in my opinion was very probably intravesical pressure perhaps secondary to a central lesion impossible of demonstration.

In analyzing the sixteen cases reported in Kretschmer's article it is interesting to note that Cases 6, 8 and 16 give a definite history of obstruction to urination so that intravesical pressure may have been the predominating etiological factor in causing the incompetency of the ureterovesical valves. Cases 1, 5 and 7 give a definite history of the trouble being in the kidney region so that they can be looked upon as probable cause of ureterovesical incompetency the result of a descending infection and can therefore be classified with three of Hagner's cases. Case 9, 10, 11, 13 and 15 are reported with no history of onset only the cystoscopic findings being given so that it is quite impossible to speculate as to their etiology. This leaves Case 4 which is reported by Israel as following childbirth and being ushered in by bladder cramp. He made no X-ray with halfo



the following table shows the results of the investigation of the cases reported in the literature. The table is organized into columns representing different categories of cases, with the first column being the most detailed and the subsequent columns being more general. The data is presented in a tabular format with rows and columns of text.

g. C. & O.

8

producing fluid but one kidney was enough diserved to require nephrectomy. This fact suggests that very possibly renal infection was the cause of the cystitis so that this case probably belongs with Hagner's group of descending infection.

To the above cases I wish to add one which bears out Hagner's theory of inflammatory infiltration as a cause of ureterovesical valvular incompetency but which differs from his cases in that the inflammation apparently started in the bladder instead of in the kidneys.

*History.* October 3, 1916. Female age 1. Following difficult labor 18 months ago she had dysuria and incontinence. This was so marked that her urine dripped constantly and her bladder felt on fire. Her condition embarrassed her to such an extent that she had not left the house for over a year, being almost constantly confined to bed. She had no pain other than in her bladder. Her general health as excellent.

General physical examination showed a fairly well nourished girl with no tenderness anywhere except over the bladder. No fever and no leukocytosis. Cystoscopic examination showed a bladder so small that it could hardly be dilated enough to get any vision. The wall was covered with a thick whitish membrane which when peeled off left a raw bleeding surface. Neither ureteral opening could be located easily and the examination was so painful that a prolonged search was not attempted.

#### Diagnosis: interstitial cystitis.

*Treatment.* At first the various antiseptics were used but they increased her pain so that they had to be given up after a week's effort with no benefit. It was then I made use of a suggestion which I first saw in an article by Caulk of using *Bulgaria bacillus* mixed with an ounce of an emulsion of *Bulgaria bacillus* with an ounce of saturated sugar solution and injecting it into the urethra with a blunt nosed syringe. Within 48 hours she was relieved of pain and within 4 days she began to have a little control of her bladder sphincter. These daily injections were continued and she improved so that at the end of a month I could cystoscope her with ease.

At second cystoscopic examination the bladder could be dilated to 15 cubic centimeters. The wall showed chronic cystitis. The right ureteral opening dilated to 6 millimeters in diameter. It admitted a No. 1

catheter easily and cloudy urine flowed freely. A specimen sent to the laboratory was reported filled with pus cells. The left ureteral opening was dilated to 5 millimeters in diameter. It admitted a No. 7 F catheter easily and cloudy urine flowed freely. A specimen sent to the laboratory was reported filled with pus cells.

A differential renal function test was made by injecting 6 milligrams of phenolsulphonethylamine intravenously. The right kidney excreted it in 4 minutes and in 15 minutes 7 per cent the left kidney excreted it in 4 minutes and in 15 minutes 7 per cent. There was bladder leakage around the catheters 15 per cent.

A roentgenogram was taken after introducing by gravity through a bladder catheter as much as 15 per cent thorium as she could comfortably stand. This picture showed in Figure 1. It demonstrates a small bladder with incompetent ureterovesical valves and approximately normal renal pelvises.

Within two months after beginning the bulgaris bacillus injection the patient could hold her urine for an hour at a time and she left the hospital to go to work. A month later she returned at my request for another cystoscopy.

A third cystoscopic examination showed the bladder capacity only 150 cubic centimeters. The mucosa was normal. The right ureteral opening was 15 millimeters in diameter. The left ureteral opening closed almost to normal size.

A second roentgenogram was taken as before and every little of the thorium ascended into the left ureter but the right valve is still quite incompetent.

The patient is now at work and is apparently in the best of health.

#### CONCLUSION

1. Acute interstitial cystitis may cause incompetence of the ureterovesical valves with an ascending pyelitis even when there is no history of retention or sign of bladder distention.

2. That treatment of interstitial cystitis by injection with *Bulgaria bacillus* may be a valuable aid.

3. That recovery of the normal function of the ureterovesical valves after prolonged incompetency is a problem of which we know little and it is to be hoped that urologists will make a point of noting the degree of recovery in reporting such cases.

## AN OPERATION FOR THE PRODUCTION OF STERILITY

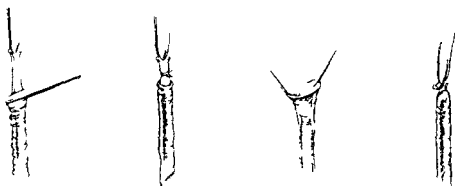
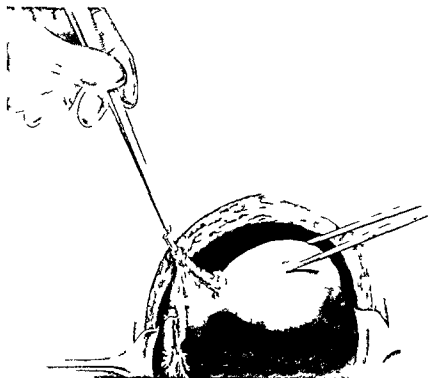
By RALPH C. CUILER, M.D., F.A.C.S., CHICAGO

Professor of Clinical Gynecology and Obstetrics, St. Anthony Hospital

IT is occasionally important to sterilize a woman without removal of any of the organs. Simple tying, section or excision of the tube is recommended by Blundell in 1812 as quite inadequate as the lumen of the tube becomes readily reestablished. Abolition of the tubes and wedge

shaped section being removed from each uterine cornu including the tubal mucosa is safe. Also division of the tube and the cut end covered with broad ligament is considered safe.

During the past ten years I have used successfully the operation to be described. I have had



opportunity to observe the result of the procedure many years after it was performed and on each occasion there was no attempt by the tube to reestablish it. In favor of this method is the fact that the tube can be made permanent by alpingotomy or endometrial resection.

This operation can be done rapidly and effectively. It results in 100 percent of the cases. There is only a small portion of the oviduct removed. It is based on a sound surgical principle. Crucial out of the mucosa thereby doing away

with the endothelial cell bringing in contact the ribbon of connective tissue gives to us a condition most favorable to healing and minimizes the possibility of the endothelial cell regeneration and the consequent reformation of the duct. It is quite true and is keenly recognized that the operation of election in any surgical condition is the one that gives the most to the patient. I simply present my experience in the management of this class of cases and the method I have used.

**Operation.** Infiltration or general anæsthesia. The abdomen is opened by a suprapubic median incision. The tube is delivered and held in a position to be easily handled. A No. 1 catgut is placed around a small artery in the broad ligament

including the blood vessel supplying a limited part of the tube. The tube is then divided and a peritoneal cuff on the proximal end is turned back the denuded muscle and mucosa is crushed in the bite of an angiostribe. No catgut ligature is applied in the crease the cuff is brought over and a ligature applied. The distal end of the tube is ligated and both ends approximated and the rent in the broad ligament closed. The relation of the structures now appear quite normal. The opposite tube is treated in the same manner and the abdomen is closed in the usual way. The operation can be done by the vaginal route. I have used it in the vaginal interposition operation for procidentia uteri.

## LOWE'S COLOSTOMY RECEPTACLE

By CAPTAIN HOPKIN A. LOWE, M.C., U.S.A.

B. H. P. L. C. M. P. S. S. I. B. Y. M.

I AM prompted to report this apparatus because it has proven a success in my hands and is I think a distinct improvement over ones commonly used.

The unfortunates who have to spend the balance of their days or even part of them with colostomy openings are entitled to everything possible that will make their condition more bearable and if this will help in only a small way I shall feel grateful. The apparatus is simple, efficient and can be self-adjusted.

It is constructed like the ordinary colostomy receptacle with the pneumatic ring and rubber pouch. Instead of being held in place by a belt it is held by an ordinary truss spring which distributes an equal pressure around the opening. The pressure remains constant with changes of the body position and therefore prevents leakage. The advantages claimed are:

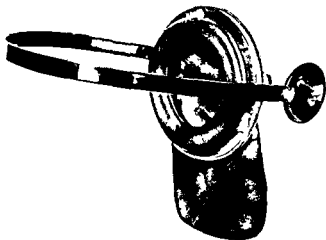
1. The spring attachment keeps a constant pressure on the pneumatic ring which is equally distributed and prevents leakage.

2. Does away with the perineal strap and belt.

3. The constant pressure of the spring preserves the contour of the abdomen and prevents the tendency to hernia.

In this connection I should like to point out a few of the salient points in dealing with colostomies. The incision should be made well toward the median line opposite the anterior superior spine if a receptacle is to be worn

otherwise the rim of the receptacle will encroach upon the crest of the ilium and make it hard to adjust to prevent leakage. Constant pressure against the bone also produces irritation and makes the apparatus uncomfortable.



The skin and fascia incision should always be small with close approximation of the skin and fascia to bowel allowing it to remain thus for twenty-four to forty-eight hours depending on amount of obstruction. Before opening the bowel. If it is necessary to explore the abdomen a median incision or rectal incision should be employed. The colostomy incision should never be made large enough for an exploratory operation.

## THE POCKET METHOD OF CLOSING SKIN DEFECTS

By JOSEPH E. FULD, M.D., NEW YORK

I O rat s g r y C H f Ph y d G 15 H C l m b L r y A 1 g S eo

THE successful outcome in plastic operation depends far more on careful attention to detail than anything else. Every possible effort should be made to observe the apparently minor point. If the operation is a failure, the final result may be even worse than the original deformity and in many cases the operation cannot be repeated.

The pocket method of skin grafting consists in raising a bridge of skin and subcutaneous tissue from the underlying aponeurosis in order to bring the part to be grafted and having it there until union between the raw surface has taken place when the two pedicles are cut. It is very important to take a Wasermann and never to operate while there is an active syphilitic process.

This method is indicated when it is necessary to cover large skin defects of extremities as after injuries of hand with laceration or foot especially about the joint to remove cicatrices which bind down tendon and interfere with action of muscles or their tendon and to restore flexion or extension.

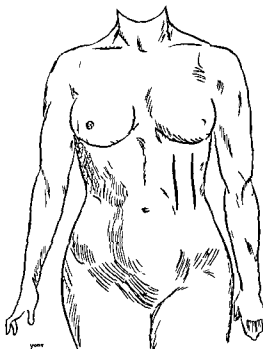


FIG. 1. Insufficient pedicle graft.

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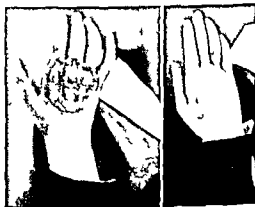


FIG. 2. (a) Insufficient pedicle graft. (b) Sufficient pedicle graft.

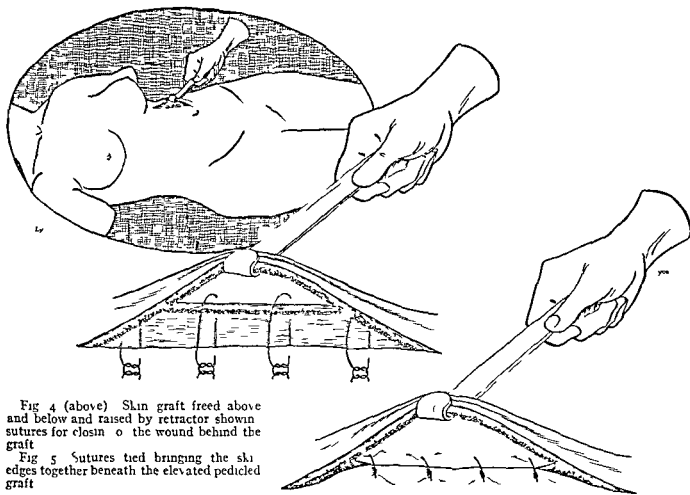


Fig 4 (above) Skin graft freed above and below and raised by retractor shown sutures for closing the wound behind the graft

Fig 5 Sutures tied bringing the skin edges together beneath the elevated pedicled graft

the wound were sutured together under this flap so as to restore the continuity of the abdomen

The patient's hand was now passed beneath the flap with the palm facing the abdomen and the dorsum in contact with the under surface of the flap. The skin edges of the hand wound were sutured to the flap which must be gently handled carefully adjusted and precisely sutured as accuracy of apposition is essential. From the natural contractility of the skin it contracts and shrinks considerably so it must therefore be one third wider than the defect to be filled and longer than apparently necessary to avoid undue contractility on the pedicles. Perfect haemostasis, strict asepsis and antisepsis are necessary to assure success. The flap held in its entirety. The sutured edges were united by primary union. The cut edges of the flap bled freely which spoke well for a successful outcome. The freshly cut edges were now sutured to the hand and a dry gauze dressing held in position by a bandage applied. The position in which the hand is held is a very comfortable one. The hand and arm must be kept perfectly still for 15 days and the best way to procure this immobilization is to retain arm against abdomen with adhesive plaster.

The graft released from its pedicle 15 days after the operation.

Under local anaesthesia on the 15th both pedicles of the bridge flap were entirely severed and the hand released from the abdomen. The cut edges of the flap bled freely which spoke well for a successful outcome. The freshly cut edges were now sutured to the hand and a dry dressing applied.

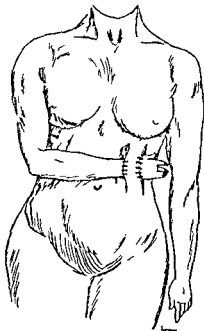


Fig 6 Hand passed beneath the flap with the palmar surface facing the abdomen and the dorsum in contact with the under surface of the flap. The skin edges of the hand are sutured to the skin graft.

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### CONCLUSIONS

The advantages of this method far outweigh the disadvantages of a two stage operation

1 The blood supply from two pedicles insures the necessary viability

There is no stimulation of connective tissue formation and resultant cicatricial contraction

3 The presence of fat in the flap prevents adhesions to the tendons below

4 The raw surfaces are approximated and held in position with ease

5 The two pedicles act as splints to hold the grafted portion in position

6 At least six weeks is saved in healing time

7 The excellent pressure surface is of great advantage in this part of the body exposed as it is to rough usage traumatism constant flexion and extension

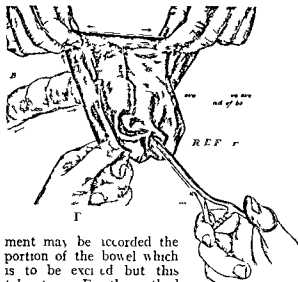
8 Finally it is the method of choice when the sliding method is impractical

## A SIMPLE METHOD OF EXCLUDING THE SEPTIC END OF THE BOWEL DURING INTESTINAL RESECTION

By R E FARR MD FACS MINNEAPOLIS MINNESOTA

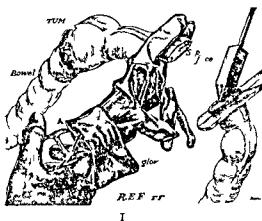
IN doing an intestinal resection numerous methods have been devised for protecting the peritoneal cavity from contamination. The remainin end of the bowel may be sterilized by cauterization or inverted and the same treat

which have been inserted into two fingers of a sterilized glove (Fig 1) After the division of the bowel by knife scissors or cautery the end that is to remain may be treated in the usual manner. The end which is to be removed is held in the



ment may be accorded the portion of the bowel which is to be excised but this takes time. For the method recommended the materials are always at hand and the septic bowel may be excluded in an instant after its division without the slightest possibility of contamination.

At the first point of division of the bowel a heavy clamp is placed upon the portion which is to remain while the portion to be excised is grasped by a long handled forcep the blades of



forceps as illustrated (Fig 1) the operator then grasps the glove at point C with his left hand and his assistant grasps the glove at points A and P. By making traction the sleeve of the glove assumes a triangular form (Fig 2) the septic end is then made to disappear by making traction upon the forcep the glove being turned inside out over the bowel and there securely clamped by means of a forceps.

This principle may be applied in many other operations where a septic mass with a pedicle is to be isolated.

# SIMPLIFIED TECHNIQUE FOR THE INTRAVENOUS INJECTION OF SALVARSAN OR ANTITOXIN IN COMBINATION WITH NORMAL SALT SOLUTION

By PETER C. CLEMENSEN M.D. CHICAGO

ABOUT two years ago I began using normal salt solution more or less regularly in all intravenous injections of salvarsan and the newer preparations diarsenol, arsenobenzol and nov arsenobenzol. I had noticed that the watery solution prepared according to the directions of the manufacturer would in many patients cause a painful sensation in the vein. I think most physicians will bear me out as having observed similar symptoms.

Also I preferred to use the salt solution because with it it is possible to inject any fluid into the vein very slowly at blood temperature 100° F. This cannot otherwise be done with a small volume of fluid as it cools too rapidly. Since I started to give antitoxins intravenously I have observed that it is very important that the serum be heated to blood temperature before starting to inject it and to maintain it at that temperature until it is all injected.

The apparatus which I have devised for this purpose consists of a quart flask, a rubber cork<sup>1</sup> with two quarter inch holes, two pieces of one fourth inch glass tubing, a large thermometer one fourth inches in diameter, two lengths of pure para rubber hose, two glass hose connections, one of them ground in one end to fit a Fordyce needle, one 10 cubic centimeter Luer syringe, one Fordyce needle, a piece of rubber hose and a pair of artery forceps for a constrictor for the arm.

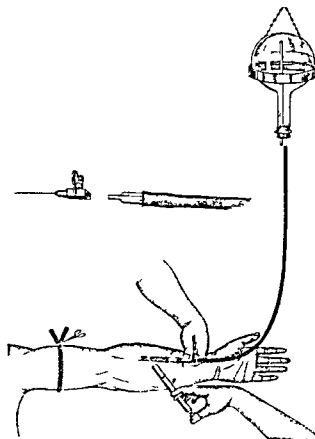
The technique I use is as follows:

Several flasks of normal salt solution are sterilized and corked with cotton stoppers covered with gutta serena tissue and are ready for use. I remove the gutta serena and cotton stopper and in its place insert the rubber cork in the flask with the short glass tube and the thermometer (all previously sterilized). Then the flask is placed on an asbestos pad over a Bunsen burner (or gas stove) and heated until the salt solution shows a temperature of 110° F.

The thermometer is removed and the long glass tube inserted through the hole in the cork which it formerly occupied. This tube should be brought close to the bottom of the flask as it is to act as an air tube. The sterilized rubber hoses

and their connections are now fastened to the short glass tube in the flask and the same inverted and held by an assistant or suspended in a ring holder *A* as illustrated.

The arm to be used for the injection having previously been prepared is placed at right angles to the body and the constrictor rubber band *D* stretched and clamped about the arm to bring out the veins. The Fordyce needle is next inserted into the vein. The blood will ooze freely from the needle if it is in the vein until the rubber constrictor is removed, which by the way is done at this time. I now allow the salt solution to run through the hose (be sure to have the glass connection *B* connected to the hose) for in that way all the air is quickly removed from the hose.



Author's apparatus showing method of administering salvarsan or antitoxin in combination with normal salt solution.

<sup>1</sup> The rubber cork is heated in the flask and is red.



When all the air is out of the hose let a little of the salt solution run into a medicine glass and test it (by an ordinary fever thermometer) to see if it tests 100 F. If it does connect the ground end of tube *B* to the Fordyce needle *C* and allow the salt solution to run into the vein.

I use the short hose marked *E* as a sort of outside vein into which I jab the needle of my anti-toxin (or salvarsan) syringe marked *F*. By gentle pressure the contents of the syringe is now allowed to flow into the hose to mix with the warm salt solution. If too much pressure is used the

solution from the syringe *F* immediately backs up and shows in the glass tube *G* which acts as an indicator and assures a perfect mixture and flow.

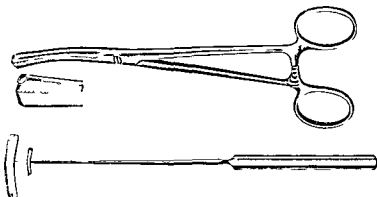
It might be of some interest to mention that I started to use this apparatus in injecting physiological sea salt solutions with salvarsan in some cases of syphilis of the liver which resisted all forms of anti-syphilitic treatment. But I now like this apparatus so well that I use it in all cases of intravenous injection of salt solution and combination of the solution.

## A NEW FORCEPS FOR THE CONTROL OF HÆMORRHAGE AFTER THE REMOVAL OF TONSILS

By WILLIAM A. GROSS, M.D., CHICAGO

THE common method of controlling hæmorrhage in surgery is that of applying an artery forceps and ligature wherever possible or practical. This procedure of hæmostasis may also apply to throat surgery. However

which is then pushed down as far as possible whereupon the tympanometer is placed in position. After placing both ends of the ligature into the slots of the tyer, the free ligature ends are held in one hand while pushing with a seesaw



more or less difficulty has been experienced in the past in applying forceps and ligature in such cases owing to the inaccessibility of the field of operation.

The object of the forceps illustrated is to simplify this procedure in surgery of the throat and other operative fields where difficulty is experienced in applying the ordinary hæmostat. The special hæmostat has a groove at the end of one of the jaws in which a piece of No. 1 catgut is inserted. After sponging the cavity the hæmostat with the ligature in position is applied to the bleeding point. One end of the ligature is swung around the forceps and a double knot is tied

motion firmly down with the other hand until the knot is firm. Then the tyer is released and with the forceps remaining in position the second knot which has been made with a single twist is pushed down into position with considerable pressure. After completing the knot the tyer is removed and the free ends of the ligature are cut off with a pair of scissors and the forceps may be removed.

The hæmostat is so designed that the knot will slip easily over the ends of the instrument which obviates the difficulty heretofore found in applying the ordinary artery forceps in a cavity such as is left after removing a tonsil.

## ANTHRAX

## REPORT OF A CASE

By LOUIS J. PRITZKER, M.D., CHICAGO

C. TAY. M.C. U.S.A. Chief Fifth Surgical Division, U.S. General Hospital, Fort S. Elling, Missouri

**B**ECAUSE of certain unusual features the following case is reported at the suggestion of the Commanding Officer Major A. Schuyler Clark, M.C.

Private W. I. T. Infantry was admitted to the Surgical Service on August 19, 1918. He had been transferred thereto from the Medical Service with the diagnosis of anthrax.

On admission the following history as obtained from patient: On June 23, 1918, when patient noticed a small pimple at about one inch below the angle of his right jaw. The morning following the right side of his neck became considerably swollen and stiff; he felt as if it were paralyzed and produced a choking sensation though it was not very painful. At that time too the pimple was discharging a little, and the patient felt generally uncomfortable, very feverish and chilly but not weak.

About a month ago the patient visited a shed containing straw that had been lying around for some time and was damp. He gathered some of this straw, stuffed a tick with it and used it as a bed up to within about two weeks of the onset of symptoms. This was absolutely all the information that could be obtained on very careful and painstaking questioning of the patient as regards his coming directly or indirectly in contact with horses, cattle or sheep.

On June 7, 1918, he became very sick, was taken off of a transport train on which he was a passenger brought to this hospital and admitted to the Medical Service. On that day his condition as described in the records was as follows: "Man came in very ill with marked swelling of right side of neck and jaw with a large pustule beneath the angle of the jaw. Appearance raised, elevated border with depressed center, looking dark and gangrenous. Swelling extended downward over upper part of sternum. Very painful, red and resembling erysipelas. Marked adenitis, patient unable to move head. Temperature 103.2, pulse 102, respirations 24. In the afternoon of the same day his temperature rose to 104, pulse 110, respirations 36. The same afternoon a blood examination by Lieut. W. J. Carson, M.C., showed white corpuscles 20,000, hemoglobin 90 per cent, small mononuclears 8, large mononuclears 2, transitional 1, polymorphonuclears 88, and eosinophiles. Blood smear, red post-e for antithroat swabbin showed the prevailing organism to be the bacillus anthracis. Swabbin from the nose was negative for anthrax but showed staphylococci. Urinalysis negative."

The treatment consisted principally of the injection of ten (10) drops of a 10 per cent solution of carbolic acid in glycerine for successive doses at four hour intervals. The first dose was given intravenously, the subsequent ones intramuscularly. In the morning of June 28, the temperature dropped to 102, pulse 92, and in the afternoon of the same day there was a further drop of temperature to 99.2, pulse 9. Thereafter the temperature, pulse and respirations varied between 96 and 98.6, 54 and 88, and 14 and 24 respectively until the termination of the illness.

On August 19, 1918 (the day of transfer of the patient to the Surgical Service) his condition was found to be as follows: temperature 97, pulse 68, right sternocleidomastoid and pectoral muscles indurated, causing limited motion of the head, edema and swelling about the site of a hen's egg over right sternoclavicular articulation, no open wound but a scar about one inch below and slightly external to the right angle of the jaw.

A specimen of blood obtained from the patient was sent to the laboratory for examination and a large hot boric acid dressing applied over the swelling. On August 2, 1918, the laboratory report by Sgt. 1st Class D. Cross, M.C., read as follows: red corpuscles 5,000,000, white corpuscles 8,400, blood culture positive for anthrax. On August 27, a saline solution of this culture was injected intravenously into a rabbit. Results and post-mortem findings are appended herewith. On September 6, 1918, another specimen of blood from the patient was studied by Lieutenant D. B. Poach, M.C., in this instance too the report of positive cultural findings for anthrax was returned. A specimen of this latter culture was injected intraperitoneally into a guinea pig and the results of this is also appended herewith.

The treatment of the patient at this time was principally supportive plus the local daily application of large hot boric acid dressings, which applications were later changed to the following:

|                      |     |
|----------------------|-----|
| R                    | Gms |
| Extracti belladonnae | 4   |
| Plumbi iodidi        | 4   |
| Lanolini q. s. ad    | 30  |

The patient kept steadily improving and by the middle of September there was no longer a vestige left of the swelling or any of the symptoms. Repeated examinations of blood, throat and no cultures and fecal analysis and urinalyses all showed negative results.

The unusual features in this case are (1) the extraordinary long period of incubation (if the history is to be relied on), (2) the persistence of the bacillus anthracis in the blood from practically the first day of the illness up to almost the time of complete recovery, and (3) the demonstrability of the bacillus in the blood.

With reference to the latter we find the following in literature: Osler (1). It is to be remembered that the blood may not show the bacilli in numbers until shortly before death. Simon (2). Adequate data from which a blood picture of anthrax could be constructed are wanting. In infections of some of the lower animals the corresponding organism may be demonstrated in the blood in large numbers. In man this is apparently possible only in exceptional instances late in the disease when general

septicæmia has developed and even then not in all cases. Hiss and Zinsser (3). Although the bacilli are not demonstrable in the blood until just before death they nevertheless invade the blood and lymph streams immediately after inoculation and are conveyed by these to all the organs.

h d the l c t r t thr lke lo s On l t  
7 e do h l f c b c t m te f sal ag sl t  
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By L i f P i f d S e g C A top y e  
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th S p t m b o a n th p e c u m e of blood f o m  
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A t p y h d th t t l o n g p t h of i n o c u l t  
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j u a t t f u l t Th p l e n l g d a n d o  
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9 8 4th d p 5

## PERITONEAL DRAINAGE

B. C. L. HEALD M.D. F.A.C.S. CEDAR RAPIDS IOWA

THE impossibility of continuous drainage of the peritoneal cavity has been proved conclusively by animal experimentation. With in a few hours probably less than 4 adhesions completely isolate the drain tract. Any drainage after that is from the drain tract alone. Yet clinical experience has proved the necessity of some form of drainage in the presence of pyogenic peritoneal infection. Since all drainage from the peritoneal cavity ceases after 4 hours whatever benefit it brings must be secured during that brief period.

Tube drainage of the abdominal cavity is a most rare thing and depends upon the overflow. Dependent drainage can only occasionally be employed. Mikulitz long ago was convinced of the physical and pathological impossibility of ideal tube drainage (Yates).

Gauze as a drain depends upon capillarity, and as soon as it becomes saturated ceases to drain becoming an obstruction to drainage.

Free pus in the peritoneal cavity may be removed by exposure and sponging or by irrigation

but both these procedures may be attended with grave danger and in many cases it is safer not to attempt to remove the pus at the operation but to rely upon rapid efficient drainage. To such cases Murphy referred in his dictum "Get in quick, get out quicker."

Ideal peritoneal drainage should remove the pus from the bottom of the cavity with the minimum of injury to the patient.

The double caliber glass tube with movable gauze wick as shown in the accompanying illustration comes nearer meeting these requirements than any method I have used. The double tube is one half inch in (outside) diameter. The lower end is closed except for an oval opening one eighth inch in its long diameter, one fourth inch from the lower end on each side and a small opening in the bottom. The longitudinal septum extends to one fourth inch from the lower end.

One end of a gauze wick one inch wide and several yards long is inserted in the upper end of one barrel and pushed down its lumen to the lower end with a small probe pulled out of

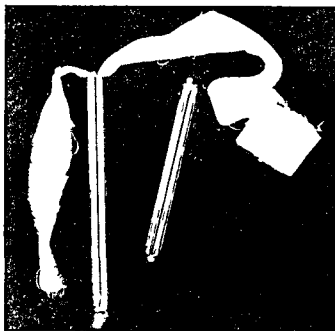
the opening in the bottom the end reinserted through this opening and pushed up through the other barrel passing around the smooth lower end of the septum

The tube threaded with the wick is inserted to the bottom of the cavity and the wound is closed completely around it. The tube should be long enough to project above the dressings which are covered and protected by a sheet of rubber dam through a small stretched opening in which the tube has been previously passed. The roll of sterile gauze wick in a cloth bag is pinned outside the dressings and covered with a sterile towel.

During the first 24 hours at more or less frequent intervals depending upon the quantity of purulent secretion the nurse with sterile gloved hands steadies the tube with one hand pulls the wick through with the other until it comes through dry cuts off and removes the soiled portion and replaces the sterile towel without having disturbed the patient. After 24 hours the tube having served its purpose is removed and replaced by a small cigaret or by any form of drain the surgeon may prefer.

The method may be used in the drainage of any cavity where dependent drainage is impracticable but in peritoneal infections from perforations it will probably be found most useful.

With this method of drainage it is not necessary to leave a large portion of the wound open as is often advisable with the usual methods result in so frequently in postoperative hernia.



It has the advantage of gauze drainage without its disadvantages.

It is similar in its effects yet superior to dependent drainage in that the tube will not with proper attention become obstructed.

It drains the bottom of the cavity while with the usual methods overflow drainage only is obtained.

Finally by this method the maximum drainage is secured during the few hours when drainage of the peritoneal cavity is possible.

## TRANSFUSION APPARATUS

BY R. E. FARR, M.D., F.A.C.S. AND E. A. L. W. GILROY, M.D., MINNEAPOLIS, MINNESOTA  
From the CLINICAL RESEARCH DEPARTMENT, ST. BARNABAS HOSPITAL

THE efficacy of the citrate method of transfusion seems to have been established. This method has made the operation comparatively simple. In order further to simplify the technique we have made use of some of the well known laboratory methods adapting them to this new field. This method of withdrawal of the donor's blood has been used by many men for various purposes but the application of the second part of the procedure we think has not been described.

The apparatus consists of a liter Erlenmeyer flask arranged in the same fashion as an ordinary laboratory wash bottle (Fig. 1) with a long glass tube extending from the bottom of the flask

through a rubber cork and outward having a bend of 45 degrees on the outside. One other

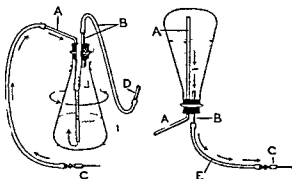


Fig. 1

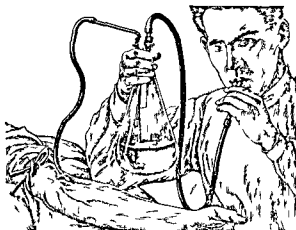


Fig 2

short tube *B* extends into the bottle about one half inch and about one and one half inches on the outside. Tube *A* is connected with a rubber tube and at the distal end of the rubber tube there is an adapter *C* to fit either a Luer or record needle. Tube *B* is plugged loosely with sterile cotton and is connected with a long rubber tube at the distal end of which there is a glass tube *D*. The glass tube is likewise plugged with cotton and is used as a mouthpiece for the operator from which point by means of suction he is able to create a negative pressure in the bottle.

In the preparation of the patient the usual technique is followed as to the application of the constrictor, sterilization, etc. Citrate solution in sufficient quantity to make a 0.2 per cent solution of the citrated blood may be introduced into the bottle before the cork is inserted or this may be done fractionally by suction after removing the adapter and placing it in citrate solution.

We usually hold the cork in place by means of adhesive tape so that the second stage of the procedure (Fig 2) may be performed without danger of the cork coming out at the time the bottle is inverted. With the mouthpiece in the operator's mouth the needle directed peripherally is inserted into the vein of the donor and by suction a negative pressure is produced in the



Fig 3

bottle. The blood then runs through tube *A* to the bottom of the flask which is continually agitated and the blood is at once intimately mixed with the citrate solution. If at any time the vacuum created is too great it may induce a valvelike action at the tip of the needle the wall of the vein closing over the orifice. In such an event the adapter is simply loosened from the needle and normal tension is restored. By this same means tube *A* may be evacuated of blood at any time and thus the possibility of the blood stagnating and clotting in the tube is eliminated.

Having completed the operation of withdrawal of the blood which operation is almost as simple as taking blood for a Wassermann the bottle is inverted (Fig 3) the long tube *A* becomes the air intake the short tube *B* becomes the tube of exit which tube *A* connected with another long rubber tube *E* in the same fashion as in the administration of saline by the gravity method.

The whole apparatus including a bottle of sodium citrate (grams 2) with needles No. 16 may be autoclaved and wrapped so that the operation can be accomplished with but little preparation and with no delay. The application of these simple laboratory methods minimizes the possibility of contamination and makes for efficiency and simplicity of operation.

## SUGGESTED STEP IN THE TECHNIQUE OF INGUINAL HERNIOTOMY

By MARSH PITZMAN M D St Louis  
L t t M d I C p U S A

THE very multitude of the modifications in the technique of inguinal herniotomy today in widespread use opens the question as to whether after all we have really gotten to the root of the matter. The essence of the Bassini suggestion that is opening the inguinal canal freely to facilitate removal of the sac and to yield a better opportunity for the repair of the musculo aponeurotic fascial layers was unquestionably a revolutionary step in the right direction. Bassini deserves lasting credit for directing the attention of surgeons to the importance of the repair of the abdominal (internal) ring in contradistinction to the previous emphasis on the subcutaneous (external) ring. My personal suggestion is simply a new technique for the surer and better closing of the abdominal ring together with the reasons for my step.

All modern herniotomy techniques split the aponeurosis of the external oblique muscle in the direction of its main bundles throughout the length of the inguinal canal. And further all techniques remove or otherwise destroy at least the inguinal portion of the hernial sac. But beyond this point all is babel. Thus for example we have the Bassini operation with and without transplantation of the cord (incidentally differences of opinion as to what constitutes transplantation) and the radically variant Ferguson Andrews technique together with the innumerable minor variations in regards steps and suture material of individual operators. Enough has been said to show that inguinal herniotomy is still far from a standardized operation and that surgeons as a class are as yet not satisfied with their technique and results.

In order to simplify our problem and to keep in touch with the spirit of the day let us confine our discussion to the typical hernia of vigorous adult life that is the indirect inguinal hernia. For among potential soldiers the direct type that is actually descending medially (internally) to the deep epigastric artery is comparatively a negligible factor. Here we have ideal conditions that is vigorous otherwise sound men and hernias of small or average size. And yet without going into statistics most of us I am sure will admit that the eventual failures of the average surgeon even in this selected class of cases are considerable while the most competent

surgeons report many disconcerting and some what unexplained recurrences. Many recurrences due to obvious causes such for example as infections chronic cough and too early return to heavy physical strain should in fairness be eliminated from the failures. But after eliminating this group a variable percentage of failures remain many of which I personally attribute to a faulty technique in the closure of the abdominal inguinal ring.

As true hernias never exist without peritoneal sacs and as such open sacs always allow the escape of intestines on the slightest increase in intra abdominal pressure nobody doubts the interdependent relationships of hernias and their sacs. But peculiarly in regard to inguinal hernia at least the argument has been generally accepted that the open sac caused the hernia to the practical exclusion of the other equally possible alternative that the hernia caused the sac. The pendulum however has begun to swing the other way as even a superficial comparison of the run of modern texts and literature with the older will demonstrate. If this is really another case of the confusion of cause and effect as many of us now feel the wideness of the acceptance of the older argument will prove an interesting subject for the psychologist and the medical historian. The gist of the newer argument is that hernia is caused by greater intra abdominal pressure than the particular wall can withstand that under such circumstances a hernia forces its way out through the musculo aponeurotic fascial layers of the abdominal wall and that the hernia causes the sac in absolute contradistinction to the older opinion that the sac caused the hernia. As I have recently briefed this argument in some detail elsewhere<sup>1</sup> I will simply state here that the past year has not caused me to wish to add or subtract one iota from that discussion.

The discussion of whether the sac causes the hernia or as many of us now believe the hernia causes the sac might at first glance seem far afield from our subject of operative technique. And yet this question of theory is the foundation on which my step in technique rests. So far as I can find out the universal custom of rectifying the sac and closing off the peritoneal cavity before proceeding to the repair of the musculo

aponeurotic fascial layers of the abdominal wall rests on the older conception of the sac causing the hernia. My suggestion in technique is simply to insert the mattress sutures for the repair of the abdominal wall while the peritoneal cavity is still open. With the finger introduced through the abdominal ring the strength and character of the tissues forming this ring can be accurately determined and the sutures carried through all the layers of the abdominal wall at appropriate points. Careful surgeons are justly afraid of sinking their needles deeply into these layers from the outside inwardly but with a finger inside the abdominal cavity no excuse seems to me pardonable for failure to get a good firm grip on all the tissues forming this ring that is the internal oblique muscle and aponeurosis the transversus (transversalis) muscle and aponeurosis and the transversus fascia. On account of fear in regard to this comparatively blind step many otherwise competent surgeons skimp the stitch until as a matter of practice they have grasped little more than the superficial muscular fibers of the internal oblique muscle. And in view of the danger of intestinal adhesions or bladder attachment in the neighborhood of the abdominal ring only a very brave or perhaps foolhardy man would attempt as deep a grasp on the tissue as he could safely accomplish from within outwardly. As far as the sac is concerned I always resect at least the inguinal portion of a thickened sac while the thin ones can be either resected or inverted as per routine techniques. But I lay so much stress on the repair of the abdominal wall and so little on the sac that I seriously doubt whether it is necessary to pay any further attention to it once the abdominal cavity has been opened.

This really completes my suggestion but here just for good measure are a few personal opinions in regard to minor points in technique. A full curved round needle is much to be preferred to any cutting edge needle or instrument as it minimizes the danger of injury to the deep epigastric artery and vein. Incidentally the term epigastric is a misnomer<sup>1</sup> as according to the rules of anatomical nomenclature it should be known as the hypogastric artery (of the abdominal wall).

As regard suture materials I feel that No. twenty day catgut will hold the tissues in apposition for a sufficient length of time to insure proper union provided the knot is tied firmly three times and the free ends are left at least

one quarter of an inch long. If the operation is not properly performed no nonabsorbable suture material will improve the result while the disadvantage of nonabsorbable sutures are too well known to call for comment. From a theoretical point of view I feel that a superficial scarification of the opposed white fibrous tissues would increase the certainty of early and proper union but have absolutely no basis except theory for this opinion. In order to obtain a clean and bloodless exposure of the required anatomical parts I make free use of the well known gauze dissection. Aseptic wound healing should be fairly firm at the end of two weeks. I have allowed some of my patients to get up at the end of two weeks and some even at ten days with so far as I could determine no deleterious effect on the six month result. For the usual indirect inguinal hernia I have long felt that the technique which most nearly reproduced the normal anatomical relations of the spermatic cord is much to be preferred to the other proposed techniques. On theoretical grounds at any rate I object to any technique which brings the spermatic cord straight out through the abdominal wall and prefer the technique which brings the cord out on its normal valve slant. In other words I make use of that Bassini technique which brings the musculo-aponeurotic fascial layers down to the inguinal ligament of Poupart deep to the spermatic cord. Finally the cut edges of the external oblique are simply sewn together superficially to the cord. And further I insist that this is the normal relation of the parts and is a herniotomy without transplantation of the cord.

In regard to practical results as any individual operator's personal experience in so big a field could be only as a drop of water compared to an ocean I will simply state that my early results have been excellent throughout. As I myself have only used this step during the past year and as hernia results should in fairness be checked up after the lapse of three to five years I lay absolutely no stress on this report of personal results. My excuse for publishing the report is based on my opinion that in the army this question is an emergency problem of some importance.

#### CONCLUSIONS

1. All types of hernia are caused by greater intra-abdominal pressure than the particular wall can withstand.

2. The newer point of view that the hernia causes the sac in contradistinction to the sac causing the hernia deserves serious consideration.

3 Greater operative emphasis should be placed on the repair of the musculo aponeurotic fascial layers of the abdominal wall

4 My suggestion in technique is that the sutures for the repair of the wall should be placed before the peritoneal cavity is closed

## CORRESPONDENCE

### ARTIFICIAL SYNOVIAL FLUID

To the Editor In June 1911 I published in SURGERY GYNECOLOGY AND OBSTETRICS an account of artificial synovial fluid a subject which always interested my classes at the school It would seem to require more or less attention now at the hospitals which are caring for soldiers with joint injuries The fluid consists in an eight ounce mixture of

|                        |      |
|------------------------|------|
|                        | 0 oz |
| Boroglyceride          | 1    |
| Glycerine              | 3    |
| Normal saline solution | 4    |

After the breaking up of adhesions and in cases of chronic inflammation of fibrous structures this

fluid injected into a joint acts mechanically in two ways

1 As a hygroscopic fluid of physical consistency somewhat resembling synovial fluid it furnishes a benign lubricant which remains in place for days or weeks furnishing an obstacle to re adhesion of joint surfaces

As a hygroscopic fluid it has a tendency to unload interstitial infiltrates from the fibrous tissues about a joint when these are congested as a result of chronic inflammation

ROBERT T MORRIS F A C S

New York

## BOOKS RECEIVED

Books received are acknowledged in this department and such acknowledgment must be regarded as a sufficient return for the courtesy of the sender Selections will be made for review in the interests of our readers and as space permits

SURGERY AT A CASUALTY CLEARING STATION By Cuthbert Wallace C M G F R C S and John Fraser M C F R C S (E) New York The Macmillan Company 918

PROTHÈSE ET CHIRURGIE CRANIO MAXILLO FACIALE By J Lebedinsky and M Vireneque Preface by M le Dr H Delagenière Paris J B Baillière and Sons 1918

TRANSACTIONS OF THE AMERICAN GYNECOLOGICAL SOCIETY Vol xliii 1918

WAR SURGERY FROM FIRING LINE TO BASE By Basil Hughes D S O M A M B B C (Cantab) B Sc (Lond) F R C S Temporary Major R A M C T F and H Stanley Banks M A M B Ch B (Glasg) Captain R A M C T C New York William Wood & Company 1919

SURGERY IN WAR By Alfred J Hull F R C S With preface by Lieut Gen T H J C Goodwin C B C M G D S O Director General Army Medical Service 2d ed Philadelphia P Blakiston Son & Co 1919

THE DISABLED SOLDIER By Douglas C McMurtrie Introduction by Jeremiah Milbank New York The Macmillan Company 1919



# AMERICAN COLLEGE OF SURGEONS

## CASE RECORDS AGAIN

HOSPITAL standardization according to the American College of Surgeons is a poor phrase to describe a good purpose. The purpose is to improve the service which sick people receive in hospitals. In its program the College has centered its aim. In effect the College says: There are many, many things to be done by the medical profession and by hospitals in the way of better care for sick people. But let us not try to do all of them at once. Let us first turn our attention to the most imperative needs of a good hospital to the needs about which there is no debate and without which no hospital may claim the approval of its community. The needs are first case records, second clinical laboratories and third staff organization.

The College has recently published two bulletins on the subject of case records, some account of which was given in the last issue of the JOURNAL. The bulletins met with heartiest response from the medical profession, from the hospital administrators and from the public. An occasional misconception however arises with regard to the records. How complete must a record be in order to be adequate? Is a usual question. Again how much laboratory work must be done in each case?

The answers to these questions obviously lie in sound medical training. A case record is not an ornament and quite as definitely a case record does not normally include laboratory work unless such work was actually needed or deemed advisable in the diagnosis or treatment of the particular case. For instance it would not be expected that a Widal should be taken in a fracture case nor would a Wassermann be expected in an obvious appendicitis but it would be regarded as highly neglectful and an evidence of slipshod work if an obscure bone disease were

permitted to proceed to operation without a Wassermann having been made.

In other words the clinical record ought to show everything that was done in each case and what was done in the case ought to include every reasonable effort to ascertain exactly what was the matter with the patient. The doing and recording of unnecessary laboratory work in a case are not only a cause of unnecessary expense but are also evidence of faulty medical or surgical practice.

But the chief difficulty in the way of adequate records today is not the laboratory phase just stated. It lies rather in the thorough study of the case first through a personal history and second through a physical examination. The confusion of the two parts of a case record is so usual that some emphasis is here given the subject.

### PERSONAL HISTORY

The personal history is in effect the patient's story of himself in relation to his complaint. It is not a diagnosis; it need not be verbose or elaborate. But the personal history should include every point likely to be of interest in leading up to the illness for which the patient came to the hospital. It included his family history, any family traits that might have a bearing on his own condition as for instance nervous manifestations. Incidents or previous illnesses of the patient may have a marked bearing on the case under discussion. An early inflammatory rheumatism for instance contracted during childhood might have a marked effect in accounting for a heart condition. A ptomaine of years ago might easily have something to do with a disturbed stomach function at the present time.

The patient should be catechised carefully as to the beginnings of his present illness, the symptoms, their extent and durations.

The parts of the body should then be discussed with the patient from his stand point he should be required to think about himself with the mind focused on one question at a time. It is not sufficient that the patient be asked whether or not he has had any previous illnesses. Has the patient ever had headache? If so what was its character? Have his ears ever troubled him? Or his eyes or nose or mouth or throat? Oftentimes a patient will entirely forget something that may be most important on which his memory is checked by reference to that particular thing.

It is not sufficient that the patient be asked whether he has ever had heart disease or anything the matter with his heart he must be quizzed about shortness of breath palpitation vertigo swelling of the feet puffiness of the eyelids. Then the physician can determine whether these incidents point to previous heart trouble.

The same detailed examination must go through every part of the body the chest the abdomen the extremities and the genito-urinary system.

Too often the personal history sheets are merely marked negative and give evidence not that the examiner has made inquiry in these different directions but that he has assumed that they had no bearing on the case.

#### THE PHYSICAL EXAMINATION

The physical examination is what the doctor finds on examination. It is not the patient's story. It is a statement of actual objective facts and this examination taken in conjunction with the personal history make up the basis of the diagnosis.

The clinician is now assumed to know what the patient has had to say about himself and the time is at hand when the patient's story is checked up by an actual examination. The obscurity or simplicity of a case will determine in the main the extent of the physical examination. The point at issue is the diagnosis and if this can be made by going direct to some indicated part of the body or to some group of symptoms and can be so plainly determined as to leave practically no ground open for debate then it would seem that this direct course is permissible. If the diagnosis

is obscure every point should be thoroughly covered and studied. It is important to remember that whatever the illness of the patient that illness bears a relation to the entire body and all significant fact in this connection should be recorded.

In the two bulletins (Vol. IV Nos. 1 and 2) full detail is given as to the distinction between a personal history and a physical examination.

Some indication of the need that the medical profession give keen attention to physical examinations is clear in the following figures. In a group of 603 hospitals in the United States and Canada last year 27.4 per cent of the patients received careful physical examinations. In this group some 1,546,000 were admitted to the care of the hospitals and later discharged without physical examinations.

#### CASE RECORDS FOR PRIVATE PATIENTS

It is considered settled that careful accurate and comprehensive case records should be kept on all ward patients in the hospital. There seems to be no argument about this. Hundreds of hospitals keep these records well. But many physicians and surgeons hesitate about keeping detailed records on their private patients and this feeling has been responsible for much carelessness in record keeping. Under such circumstances the administration of the hospital naturally concludes that if the bars are down in one place they might just as well be down in other places.

Much serious thought is due on this subject of records for private patients. The problem is difficult. Many doctors feel that their relations with their private patients are confidential and that these cases are not to be talked about by outsiders. The result is that some of these doctors keep rather accurate records in their own offices and not in the hospitals although the patients are cared for in hospitals. Other doctors keep no records at all of private patients. A woman for example has a miscarriage or has several mishaps of the sort. Obviously the case is not one for outsiders to know about. A Wassermann has been made and the result is positive which may account for the abortion. There may be a gonorrhoeal history connected with the patient or something in the story.

that goes back to a syphilitic history. Very rightly these are things which are not to be talked about.

And yet should not a full record be kept? Does not the patient himself or herself frequently suffer because of the want of an adequate record? Suppose the doctor treats a private case and makes no record of it and suppose that later he dies or that the family move away or that for some other reason a new doctor is called into the case. Is not the patient entitled to have the experience gained by the first doctor available for use under the new conditions? The answer is undoubtedly yes. The data should be

available to the patient, private or clinical.

What is to be done? Nearly all objections to the keeping of records for all patients disappear if the hospital records themselves are private and inviolable and not subject to review by any one who has not a definite right to know what the records contain. The answer is of course that hospital records are confidential data and should not be seen or known by any one excepting in the interest of the patient and on the patient's order or on the order of the doctor authorized by the patient. The protection of the records is a responsibility which the hospital owes to each doctor who practices in it.

# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE, PUBLISHED MONTHLY

VOLUME XXVIII

APRIL 1919

NUMBER 4

## THE SURGICAL TREATMENT OF EMPYEMA

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MY interest in empyema was stimulated by an investigation which I and my adjunct Dr A O Wilensky instituted in the year 1914. In tabulating statistically the results in 299 consecutive cases observed in Mount Sinai Hospital New York during the preceding 10 years we discovered that the mortality reached the formidable figure of 8 per cent. This was a rude shock to my complacency engendered largely by the conventionally indifferent attitude of most surgeons toward this malady. Of course it is barely possible that our mortality is an unusual one but conversations with numerous surgeons throughout the country lead me to believe that most of them suffer from a similar delusion that their mortality in empyema is lower than it really is.

For this reason I deemed my appointment to the Empyema Commission as a most welcome opportunity not only to study the disease *en masse* but what we so frequently miss in civil practice to observe the disease from its very inception. This paper is based entirely upon our experiences on 140 cases observed first in Camp Lee and subsequently at General Hospital No. 1, Biltmore, North Carolina.

As is already known the vast majority of these empyemata are due to infection by a hemolytic streptococcus and are coincident with or follow a peculiar form of organizing

bronchopneumonia the pathology of which has been ably described by W G MacCallum. Most of the cases follow measles. Despite the extraordinary incidence of the streptococcus as the infective agent these empyemata except in the earliest stages do not differ very markedly in their clinical aspects from the empyemata observed in civil practice which are usually due to the pneumococcus. Nevertheless it is interesting to observe that even in civil practice as the records of 574 examinations of pleural exudates in Mount Sinai Hospital show 133 were caused by a streptococcus. The significance of these figures did not regrettably appear to us.

For purposes of study streptococcus empyema must be divided into three stages (1) the formative (2) the acute and (3) the chronic stage.

### I. THE FORMATIVE STAGE

The formative stage is one of the most if not the most interesting phase of the entire problem. I shall discuss only certain aspects of these phases.

The most striking feature in contradistinction to cases seen in civil life is the extremely rapid formation of the pleural exudate. We have seen cases in which a pronounced exudate developed two days after the very onset of the illness. Cases of three or four days' duration are quite common.

The extremely rapid formation of the exudate and its still more rapid infection with myriads of virulent streptococci demand an explanation. It has always seemed to me that such gross infection of the pleural cavity cannot be accounted for by the mere contact extension of the intrapulmonary lesion. My reasoning was based first on an analogy derived from a study of peritonitis. Every surgeon with any experience knows that the most pronounced and dilute form of peritonitis are due to a rupture of an intra abdominal viscus. Of course we sometimes see a very extensive peritonitis when there has been no perforation but these are admittedly uncommon. Second year ago I made the significant observation that in a number of cases of empyema that came to autopsy there was found a pinpoint perforation of a subpleural pulmonary abscess. This observation struck me forcibly and I often wondered how common such origin for empyemata might be. For the reasons I was specially interested in the observation of autopsy results in Camp Lee and was gratified to note that such perforations were quite frequently encountered. Such origins are furthermore confirmed by other evidences in patients who recover particularly the development of pleuropulmonary fistulas is determined by irrigations with Dakin's solution by X-ray examinations and by actual inspection at subsequent operation.

The treatment of the cases in this the formative stage of an empyema is principally that of the underlying malady and may be termed in very crude language supportive. Of tremendous importance and in some cases even of deciding moment is the question of nutrition. I cannot enter into a detailed discussion of this phase at this place but refer all those interested to the preliminary report of the Empyema Commission which was published in the *Journal of the American Medical Association* for August 3 and August 1, 1918.

Whenever there is a suspicion of an exudate into the pleura its presence and character should be verified by exploratory aspiration. In the early stages this fluid is varicolored and only slightly turbid occasionally it is sanguinolent. The early turbidity is only partial, due to the presence of pus cells although a

number of these can be discerned on microscopic examination more frequently it is due to the presence of myriads of streptococci. As already stated the exudate usually teems with streptococci but peculiar as it may appear the streptococci in spite of the apparently excellent nutritive medium not only do not multiply but on the contrary they frequently disappear altogether and large bottles of exudate may keep sweet for an indefinite length of time.

The most important advice which the Commission offers as regards the treatment of these empyemata during this stage is not to operate. When the fluid causes a serious embarrassment of the respiration and circulation as evidenced by dyspnoea cyanosis and rapid pulse it should be relieved very promptly by evacuating it with a Potain or Dieulafoy aspirator. This procedure should be repeated as often as indicated if necessary even daily. In rare instances this procedure may even be curative. Exception to this rule of non operative treatment is made only in cases of acute and progressive hydro or pyopneumothorax which result from the rupture of a large subpleural pulmonary abscess communicating with a bronchus of considerable size. In these very prompt operative interference is indicated.

This recommendation of delayed operation is based upon the marked improvement in the mortality statistics since the adoption of this course and also upon the very high mortality in camp in which operation were undertaken promptly upon the discovery of the infected exudate. These are the practical reasons but there are sound theoretical grounds as well. At an early stage of an empyema the fluid is free within the pleural cavity and there are practically none or only very slight limiting adhesions in other words we are dealing with a free hydrothorax or if one so chose to call it a pyothorax. If an operation is undertaken at this stage we convert the only slightly dangerous hydrothorax into the extremely dangerous hyperacute pneumothorax. This brings about the justly dreaded fluttering of the mediastinum with ultimate fixation on the opposite side of the thorax. Therefore instead of attaining

the desired object namely to relieve the embarrassed respiration and heart action the operation only aggravates it

There are a number of other perhaps less important reasons which favor a delayed operation. The patients are usually very ill from the pneumonia with its attendant high toxicity so that even the simple operation of thoracotomy or rib resection done under local anaesthesia is badly borne. Miller in his report records that many of his patients died promptly after the operation.

Nor can I see any very material advantage in operations which may be termed intermediate for instance the institution of permanent drainage of the pleura by means of a trocar and subsequent introduction of a catheter. Even with the greatest precaution air enters the chest sooner or later with consequent collapse of the lung. Attempts at maintaining a continuous negative pressure have not been very successful.

The after treatment of early operations is particularly difficult. If a collapse of the lung has once occurred the organ rapidly becomes adherent in its new location usually high up in the thorax and close to the vertebral column. If such a patient is fortunate enough to recover from the primary insult there is usually formed an enormous cavity which requires a long time and multiple operations before final closure is obtained. Some of the worst cases I have had to treat were such as were operated on in the earliest stages.

It may be argued that inasmuch as we have learned that early operation is best for peritonitis therefore early operation should be advocated for suppurative pleuritis. It must not be forgotten however that even if the pleura is anatomically and physiologically identical with the peritoneum we are dealing in the thorax with certain static conditions which are entirely lacking in the abdomen. Furthermore we must recognize that the functions of the thoracic viscera are vital and that the cessation of these functions for even a very short period is incompatible with life a function the dignity of which is at no time approached by the abdominal viscera.

At this stage the empyema is not the serious element in the illness it is the pneumonia

In view of these facts I can only close this part of my paper with the urgent admonition *nil nocere*.

If the patient is not operated upon at this stage the exudate loses its seropurulent character and becomes converted into frank thick creamy pus. Coincident with this conversion a most important change occurs upon the pleural surfaces adhesions form between contiguous portions of the visceral and parietal serosa at the periphery of the exudate which collects in the supradiaphragmatic portion of the thorax. In other words by waiting we have converted the pre-existing free seropurulent pleurisy into a closed purulent pleurisy or empyema shut in everywhere by limiting adhesions and thus we have arrived at the second stage.

In anticipation of what I shall have to say later on concerning recurrences or relapses of empyemata I shall briefly mention in passing that in a certain number of cases the process is not quite as simple as this. Adhesions may form in other portions of the thorax and give rise to abscesses which may exist singly or in combination with the classical type of empyema. I believe the term multilocular empyema is better than the conventional one of encapsulated empyema for these cases because strictly speaking every true empyema is encapsulated.

## 2 THE ACUTE STAGE

When this stage has been reached the general condition of the patient has improved to a very marked degree. The temperature is usually lower and all symptoms and physical signs are improved.

This is the most propitious time for operation. As the lung is adherent at the periphery of the pus there is no more danger of a further collapse of the lung. The lung is already compressed to the extent of the encapsulated pus and no matter how large an opening is made the lung cannot collapse further.

From a viewpoint of therapeutics this part of my paper is perhaps the most important. Trivial as the operation is each step requires the greatest punctiliousness in its carrying out.

Before the operation a final N ray or fluor

oscopic examination is made in order to determine the most favorable site for the operation.

The subsequent steps may be subdivided under the following heading:

1. *Anesthesia*—All operation at this stage can and should be carried out under local anesthesia. Novaine or procaine in 1 or 2 per cent solution is the anesthetic of choice. The line of the incision is first injected subdermatically and from this area the deeper tissues are very thoroughly infiltrated. A simple intercostal incision is preferable. If however resection of the rib is considered advisable it is important to destroy the great sensibility of the pectoral region by injecting it separately with a fine hypodermic needle. On the other hand the division of the rib does not appear to be particularly painful. I believe that with the exercise of care and gentleness a general anesthesia is hardly ever necessary. In some cases I have attempted conductive anesthesia of the nerve trunks but I am not certain that I would ever have been completely successful without any additional local infiltration. Failure to obtain a perfect anesthetic was very probably due to faulty technique.

*The supracostal incision*—(a) *The site of the incision*—In general the site of the incision depends upon the location of the empyema as guided by the physical examination and the X-ray plate. The incision must fulfill two purposes: first it must afford adequate drainage and second it must permit appropriate medication of the cavity. The drainage must be free and unobstructed both in the recumbent and erect posture. In the most common location of empyema, i. e. those which occupy the lower part of the thorax the incision is made in the eighth intercostal space just behind the posterior axillary line. Theoretically objection might be raised to this location by the fact that the ascent of the lymphatics which occurs in the course of healing of any empyema might cause a kinking of the drainage tube but in practice this does not occur. Obviously when the empyema is localized in other portions of the thorax the incision is made directly over it and at its most dependent portion.

b. *The incision of the extrapleural soft part*—The cutaneous incision should be of ample length (two to four inches depending upon the amount of adipose tissue present) so that with proper retraction all subsequent steps can be carried out under the guidance of the eye. It is important to remember that the incision made with the arm hyperabducted will shift when the dependent position of the arm is restored. If this is not considered the surgeon finds that his cutaneous incision is not in alignment with the pleural incision. This is a circumstance which is extremely annoying in the after treatment and may require a second incision at right angles to the first. It is readily obviated by outlining the incision while the arm is in the adducted position.

3. *The incision of the pleura*—In primary operations proper drainage is obtainable in about 90 per cent of the cases by a simple intercostal incision of the pleura. This is one of the points wherein I differ from the usually accepted teachings that resection of the rib is an absolute essential. I have not encountered in a single instance the frequently discussed and greatly feared compression of the drainage tube. In secondary empyemas however is the case in which one empyemic cavity had already been drained and the healing of which has caused a certain amount of approximation of the ribs, one to two inches of the lower rib exposed in the operation must be resected.

I am in favor of simple intercostal incision because it is simple, takes little time and especially because the drainage opening is just as ample as after rib resection. Furthermore this procedure is seldom followed by necrosis of the ends of the divided rib and not infrequent cause of persistent sinuses.

4. *Drainage material*—Drainage is made through a single large size rubber tube of rather a stiff quality and about one foot long. The tube is forced through a tiny perforation in a piece of rubber dam approximately four inches square which is fixed to the tube with a thread at a distance from  $2\frac{1}{2}$  to 4 inches from its thoracic end depending upon the thickness of the chest wall. Near the thoracic end one large fenestra is cut into the tube.

The pus is slowly evacuated. I do not irrigate the cavity upon the operating table not from any fear of the irrigation but in order not to prolong the operation unduly. If any thing appears to be definitely settled in surgery it is that under no circumstances should an empyema cavity be irrigated; there is not a surgical textbook which does not deal with definiteness regarding this point. Explanations are given for this definiteness which if critically analyzed however will be found not to explain at all. Personally I believe there is a fairly good reason for it which however has not been recognized until now, namely, the frequently existing communications of the pleural cavity with the bronchial tree. As already stated I do not irrigate the cavity upon the operating table for other reasons as will be shown; however I do so very soon thereafter.

The drainage tube is introduced into the thorax so that the fenestra is just inside. This must be guarded with some care in order to permit the rubber dam to be flush with the skin. No sutures are ever employed and the external incision is simply packed with gauze. After cleansing the skin the rubber dam is laid smoothly upon it and its edges firmly attached by broad strips of adhesive plaster. A dressing is so applied that the tube (temporarily clamped) finds free egress.

Upon reaching the ward a simple combination instillation and suction apparatus is attached to the drainage tube by means of a T tube at a convenient point a second attachment is made for a bottle to receive the discharges escaping from the empyema cavity.

Once an hour or more or less frequently as indicated the syphon part of the apparatus is discontinued by clamping and the instilling part of the apparatus and Dakin container is opened and the requisite amount of solution is allowed to run in. After the lapse of five minutes the suction apparatus is reopened and the solution plus secretions syphoned out. The suction is continued until the next period of instillation.

The advantages of this combination apparatus consisting of drainage tube instillation apparatus suction apparatus and receiving bottle are the following:

- 1 All the discharges are collected into the receiving bottle and in consequence the wound does not require any change of dressings. I usually avoid for one week or 10 days the dressing of patients connected with the apparatus.

- The cavity is perfectly dry and there being no retention of pus fever does not arise.

- 3 An early opportunity is given to permit a prompt and efficient use of Dakin's solution.

- 4 The vacuum created aids to a limited extent in the expansion of the lung.

*After treatment.* All patients are dressed only once in 24 hours. All the old dressings including Carrel tubes and safety valves (to be subsequently described) are removed and are replaced by fresh ones. All rules as enunciated by Carrel for the preservation of a perfect asepsis are rigidly adhered to except some trivial details as will be mentioned.

After cleansing the skin with a dry cotton sponge followed by a sponge moistened with alcohol a soft rubber catheter (about 2 F) is connected with a Dakin container and is introduced into the empyema cavity. The cavity is thoroughly flushed the patient being turned from the lateral to the prone position and vice versa until the return flow is perfectly clean.

From one to four Carrel tubes are now introduced into the cavity the object being to distribute them into various portions of the cavity. In very long or irregular cavities we occasionally made use of tubes which were armed with a silver wire stylette. A short drainage tube with one fenestra guarded by a safety pin so called safety valve is finally introduced to permit a free escape of the Dakin solution and secretions.

Right here I might digress for a moment in order to mention that the rationale of the entire postoperative treatment must be thoroughly understood. One must not fall into the error of thinking that there is something supernatural in Dakin's solution as far as the cure of an empyema is concerned. All that the Dakin's solution can do or is expected to do is to sterilize the cavity. This however it cannot do if the other surgical principles are neglected.



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*The superficial incision*—(1) *The site of the incision*—In general the site of the incision depends upon the location of the empyema as guided by the physical examination and the X-ray plate. The incision must fulfill two purposes: first it must afford adequate drainage and second it must permit appropriate mechanical ventilation. The drainage must be free and unobstructed both in the recumbent and erect posture. In the most common location of empyema, i.e. those which occupy the lower part of the thorax, this is usually made in the eighth intercostal space just behind the posterior axillary line. Theoretically objection might be raised to this location by the fact that the ascent of the diaphragm which occurs in the course of healing of every empyema might cause a kinking of the drainage tube but in practice this does not occur. Obviously when the empyema is localized in other portions of the thorax the incision is made directly over its site and at its most dependent portion.

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Right here I might digress for a moment in order to mention that the rationale of the entire postoperative treatment must be thoroughly understood. One must not fall into the error of thinking that there is something supernatural in Dakin's solution as far as the cure of an empyema is concerned. All that the Dakin's solution can do or is expected to do is to sterilize the cavity. This however it cannot do if the other surgical principles are neglected.

The vicinity of the wound is protected by sterile vaseline gauze strips. At a distance from the wound the skin is protected from irritation by the application of a stiff zinc oxide ointment which was found to be rather more efficacious in this respect than vaseline.

A few small fluffs of dry sterile gauze are placed next to the wound and a more liberal use of reclaimed gauze or absorbent cotton completes the dressing and is held in place by a firm binder. The Carrel tubes emerge on top of the binder usually in the vicinity of the shoulder.

Definite instructions are given for the instillation of the requisite amount of Dakin's solution; the quantity depends upon the size of the cavity and varies from 25 cubic centimeters to 100 cubic centimeters (in general about one half of the volume of the cavity); it is distributed in equal amounts through all the tubes. Directions are also given as to the intervals between instillations. I have found hourly instillations to be most satisfactory.

The dressing is not touched for 4 hours. The quantities of Dakin's solution used saturate the dressings but upon inquiry patients did not complain of this seemingly annoying drawback.

Cases which are complicated by pleuro-pulmonary fistulas particularly those of large size cannot be irrigated with large amounts of Dakin's solution because of the very irritating cough which results from over distention of the cavity; they tolerate however hourly instillations of the requisite amounts in perfect comfort.

Already at the first dressing the discharge has lost its frankly purulent character. Usually the cavity is perfectly dry as all the discharges find egress through the safety valve. It is almost marvelous to see the effect of a properly carried out treatment. All pus and odor disappear as if by magic.

In some of the cases of long standing, i.e. those in which the drainage was for a while imperfect, we had an opportunity to observe the character of the discharge. Its consistency was not unlike that of uncooked white of egg in which there were enmeshed a few grayish or reddish particles. When steriliza-

tion became more complete the discharge lost this appearance and the irrigation was followed by small hemorrhages. We interpreted the first finding as due to the liquefying action of the Dakin's solution upon the dense fibrinous deposit upon the pleura and the hemorrhages as due to irritation of pleural granulations.

It is most interesting to follow in cases recently operated upon the changes caused by the Dakin's solution upon the infected pleura. When an empyema is operated upon the pleura is found coated throughout by a soft grayish deposit of varying thickness composed of pus and fibrin. As sterilization proceeds this coating disappears very rapidly exposing a smooth glistening surface particularly upon the pulmonary side; it is so thin that the underlying lung tissue becomes readily visible and recognizable.

Twice a week smears and cultures are made from the cavity. When very low counts are obtained these are made daily. When sterility is reached and is continued for several days all tubes are left out and the Carrel-Dakin treatment is discontinued. Prompt and permanent healing, the result in many instances in one case in 13 days.

In a few cases I have attempted a plastic closure of the fistulous opening but the results attained did not warrant me in continuing this practice. Moreover I do not see any particular indication for doing so. If the cavity is not sterile a premature closure of the wound is sure to be followed by an infection with subsequent breaking down of the suture line; if on the other hand it is sterile the wound closes so promptly that even the trivial operation of refreshing the edges and suturing is uncalled for.

Considerable importance is ascribed by most surgeons to the use of blowing bottles in order to encourage the lung to expand. I will not deny that this device may help but I have found that most patients after the first enthusiasm of a new toy do continue its use. I have found more benefit in properly and systematically carried out light exercises. I encourage particularly light work around the ward which keeps the patients interested and amused.

In the early part of my paper I have already emphasized the importance of keeping up the nutrition of the patients

### 3 THE CHRONIC STAGE

In this group I would place only the following cases

1 Cases which do not heal within a reasonable time

2 Cases of recurrence within the old empyema cavity

3 Cases in which a second pus focus is discovered at some distance from the original focus

4 Cases of pus collections within the parenchyma of the lung

5 Cases of bronchocutaneous fistulas

I *cases which do not heal within a reasonable time* The word reasonable permits a wide latitude in its interpretation. My views regarding the manner in which an empyema heals have undergone a very radical change since my experience in the military service. I conceived that healing occurred only by a process of obliteration of the pleural cavity due to adhesions resulting from a granulo-matous change in the pleura. Only when the entire affected pleural surfaces became adherent did the drainage opening close. When a cavity still persisted I observed that the opening showed no tendency to close.

Since this epidemic has been in existence I have been able to observe the following variations

1 The far reaching observations at the War Demonstration Hospital of the Rockefeller Institute have taught us that empyema cavities can be rendered bacteriologically sterile by means of the Carrel-Dakin treatment and the drainage opening can then be closed by secondary suture. In a fair percentage of cases union with definite closure occurs. I am not aware that the progress of healing has as yet been described in detail by the originators of the method but from personal observations I have found that a certain amount of exudation occurs though not to the full extent of the cavity. In the course of time this secondary exudate becomes absorbed and is replaced by the slowly expanding and adhering lung.

In a few cases of healed empyema I have found on casual physical and X-ray examination a very definite closed pneumothorax usually at the site of the original empyema. In one case at some distance from it. I watched these cases with great care and certainly also with fear but found that the expected reaccumulation of pus did not occur. On the contrary the cavity disappeared within about a month's time the lung expanded and completely replaced the pneumothorax.

2 We also had the following very unusual experiences. Originally they were cases of empyema which secreted large amounts of pus when they came under my care however there existed only a small sinus which led into a large cavity. The peculiarity of these cases lies in the fact that in spite of little treatment these sinuses persisted for a long time without any apparent discharge or at most a few drops in the course of a week. Ultimately however these cases closed up completely and remained closed to date.

3 Finally we have made the following observations. We have seen cases that were long under treatment with Dakin's solution. No hemolytic streptococci were found for a long time. The cavities were X-rayed periodically found to be smooth and simple and while at the beginning a certain amount of concentric diminution was noted these cavities finally remained stationary. In civil practice such cases would indicate some variety of secondary operation. However in view of the three possibilities just related a chance was taken and all treatment was discontinued. We were surprised to see such cases heal permanently.

It is seen therefore that in addition to the hitherto known so to say the classical method of the healing there exist at least four other methods. It is on this account that I find difficulty in exactly defining the words reasonable time. In general I would say that in the light of our present knowledge I would exclude from this group simple cases in which the pleura is smooth in which the cavity is not of extreme size and cases that are not complicated by side pockets or lateral sinuses. In other words I would not include in this group any empyema cavity which is

amenable to treatment by the Carrel Dakin method

If we examine the cases which cannot be remedied by even long continued treatment by the Carrel Dakin method we will find the following

- 1 Cases which are complicated by large pleuropulmonary fistulas
- 2 Cases with retained foreign bodies
- 3 Cases with side pockets
- 4 Cases with lateral branch sinuses
- 5 Cases with necrotic ribs

II *Cases of recurrence within the old empyema cavity* Broadly speaking these cases are always a reflection upon the surgeon in attendance for it means that drainage and antiseptic treatment of the cavity have been discontinued prematurely. To my mind such cases are particularly liable to occur if the sinus or external incision is closed operatively because not infrequently good judgment is supplanted by haste. Even the strictest precautions such as smears and bacteriological cultures do not always furnish a reliable guide to the presence or absence of microorganisms existing within the empyema cavity. It again only proves the absolute value of the well recognized axiom in medicine that a negative proof is no proof. That it can occur also in those cases which have been allowed to close spontaneously is well proven by the fact that we encountered recollections of fluid in eight of our cases. Six of these had definite collections of pus containing streptococci two were found to contain sterile serum. For simplicity's sake I have grouped them all under one heading though it is evident that the last two were milder and simpler and disappeared spontaneously.

III *Cases in which a second pus focus is discovered at some distance from the original empyema* In a previous portion of my paper I have already discussed the manner of formation of an empyema cavity. Occasionally encapsulation of the pus occurs elsewhere than in the supradaphragmatic portion of the thorax and as a result we may have two or more separate empyema cavities. At the time of the first operation usually only one the larger and lower one is opened. Sooner or later however it is noted that the patient

does not improve and after physical and X ray examination sometimes even long after the main cavity is healed another pus focus is found. In only one case did we find that the second pus focus broke through into the primary cavity usually it requires a second independent operation for drainage their most frequent location was in front overlying the apex of the lung and toward the apex of the axilla.

Incidentally I may mention that at post mortem examinations soon after my arrival at Camp Lee we frequently encountered small encapsulated collections of pus which were located behind the costal cartilage approximately between the anterior sharp margin of the upper lobe and the mediastinum but we have never seen such in any patient who survived.

IV *Cases of pus collections within the parenchyma of the lung* As already stated in a preceding portion of my paper I am firmly convinced that most if not all cases of empyema have their origin in one or more small subpleurally situated pulmonary abscesses which perforate into the pleural cavity. I do not refer to these at this point. I refer now to an encapsulated collection of pus within the parenchyma of the lung not connecting with either the pleura or with a bronchus of appreciable size. In the former case it usually evacuates itself into the pleura in the latter through a bronchus. The recognition of encapsulated abscesses of small size is very difficult on ordinary physical examination. Lately Lieutenant Stevens of the Empyema Commission has demonstrated by means of stereoscopic X ray plates that certain findings are quite characteristic of most pulmonary abscesses. These are the gradual formation of interstitial lung markings usually definitely radiating throughout the lung tissue from the central focus of infection and if the abscess be near the periphery a corresponding thickening of the pleura over it. It is surprising that these abscesses are not encountered more frequently in the chronic stage. I believe this is due to the fact that most of these patients succumb in the acute stage.

V *Cases of bronchocutaneous fistulas* Bronchocutaneous fistulas must not be confused

with the so frequently mentioned pleuro-pulmonary fistulas. Their etiology is of course the same, namely, a rupture of a subpleural pulmonary abscess. The difference between the two lies in the fact that whereas pleuro-pulmonary fistulas are comparatively easy to cure (in fact not infrequently they close spontaneously) bronchocutaneous fistulas never close spontaneously and usually require rather complicated procedures before a cure is obtained. The fistula usually communicates with a bronchus of some size. Their occurrence is readily explained by an adhesion of that part of the lung which bears the fistula; finally the mucous membrane of the bronchus grows outward and the cutaneous epithelium grows inward until the two meet and a so-called lip fistula forms. We have had cures in three cases of this nature.

The diagnosis of some of these conditions is self-evident; in others the diagnosis is exceedingly difficult. Constant care and attention is required to avoid numerous pitfalls and surprises. It is not within my domain to discuss the various physical signs; there is one point, however, which has struck me forcibly and which I have not seen mentioned in any one of the reports published from various camps. It may be accepted as a proven fact that when a patient is healed and cured of his empyema the cure is to all intents and purposes perfect. Such a cured patient feels well, he eats well and he sleeps well; further, more he has no fever and he gains enormously in weight; in fact many of the patients not only attain their normal weight but even go beyond it. In the presence of a slight evening rise of temperature when accompanied by a loss of weight, one should not permit himself to be deluded with the erroneous and yet frequently prevailing idea that the patient is suffering from a latent tuberculosis. We at least have not found tuberculosis in a single instance. When these symptoms are present a thorough physical examination is rigidly indicated. At some point in the thorax a suspicious area will be found which upon aspiration will yield pus when this abscess is evacuated all symptoms disappear promptly.

In draining cavities most important in formation can be obtained as regards their

outline, extent and volume by means of stereoscopic X-ray plates after injection with some substance opaque to the rays. We have tried numerous substances particularly sodium and potassium iodide 15 per cent neutral thorium nitrate solution, barium and finally have arrived at the conclusion that when properly used bismuth subnitrate or subcarbonate gives the most satisfactory results. I have purposely ruled myself of the expression properly used in discussing this phase of the subject because in addition to the well-known toxicity of bismuth salts my co-worker upon the Commission, Lieutenant Stevens, found another very important drawback, namely that in the form as originally used, i.e. a vaseline paste, it frequently failed to give a correct picture of the cavity. This is due to the fact that pastes, even if properly heated, congeal so rapidly during the process of injection that the air contained in the cavity cannot be displaced outward but is compressed into the uppermost part of the cavity and forms an effective barrier to the proper filling of the cavity. On several occasions we found upon the operating table instead of the expected short sinus as outlined with bismuth paste a sinus several inches longer. The inefficacy of bismuth pastes was clearly demonstrated upon the re-examination of several cases under our observation. Lieutenant Stevens found a solution of the problem by substituting sterilized cotton seed oil for the vaseline. A special report upon the subject is now in preparation; suffice it to say for the present that since using this method we are no longer troubled by deceptive pictures. Incidentally I believe that the danger of bismuth poisoning is thus not only minimized but practically excluded as the oil mixture escapes at once.

X-rays are particularly useful in exposing conditions in an empyema cavity the existence of which renders them difficult to sterilize with Dakin's solution. I refer especially to branch pockets, sinuses and pleuropulmonary fistulas.

#### COMPLICATIONS OF EMPYEMA

The local complications of an empyema are readily recognized and readily coped with. I maintain that an ordinary empyema has no

distant complications. Positive blood cultures in empyema are so exceptional that one is forced to the conclusion that complications which occur in the course of an empyema such as endocarditis pericarditis joint infections peritonitis etc. are due not to the empyema but to the pneumonia.

#### TREATMENT OF CHRONIC CASES

I have purposely entered into the minutest details in the description of the treatment of the acute stage of the disease because I am convinced that if the directions given are carefully followed chronic cases will occur less than we have been accustomed to meeting them and if they do occur their treatment will also be materially simplified. For the sake of completeness permit me to begin with those cases which I did not classify as chronic but which custom has hitherto placed in such a category.

*1. Large empyema cysts.* It is difficult to connote what we mean by the term large. We must recollect that extremely large cavities are always the result of a mistake namely a too early operation because adhesions have not had time to form. Our experience has also led me to believe that even cavities of very large size if properly treated and for a sufficient length of time with Dakin's solution will eventually diminish in size. I believe this diminution depends upon several factors upon the elevation of the diaphragm the approximation of the ribs to one another and finally upon the solvent action of Dakin's solution upon the dense fibrous deposit which covers the visceral pleura thereby permitting a re-expansion of the lung. If the cavity has diminished to its minimum as ascertained by means of measurements and X-ray and has become stationary and furthermore if the cavity has been sterile for a long time a chance may be taken to permit a closure of the sinus by simply discontinuing all treatment. If the outline of the cavity is so complicated that sterility is not obtainable one of the major operations is indicated. My own preference is for a simple Schede operation resecting all of the ribs which form the roof of the cavity.

There are several minor points regarding

this operation which are worthy of being alluded to. In contradistinction to similar cases in civil life these patients are usually in the very best condition and stand a general anæsthetic perfectly well in fact their condition even after the resection of 5 or 6 ribs is so good that they insist on leaving their bed upon the day succeeding their operation. A single straight incision over the greatest diameter of the cavity usually gives ample exposure. I found some difficulty in my earlier cases in the after treatment when parts of ribs lying in front of the scapula were resected because of the subsequent tendency of the scapula to cover the opening which has been made. Therefore I have lately carried my incision backward between the internal scapular and vertebral lines. This made the operative procedure somewhat more tedious but it rendered the postoperative treatment so much easier that I recommend this step very highly.

Some difficulty is encountered in excising the rib which has been resected at the first operation on account of grotesque spur and ring formations and fusions with the ribs on either side.

The intercostal tissues are ligated *en masse* at both ends the intervening portions are excised. All ribs are resected subperiosteally all the tissues particularly the greatly thickened parietal pleura are excised. We had attempted in some cases particularly favorable for the procedure to excise the fibrous deposit covering the visceral pleura (De Lorme) but contrary to our experience in civil life with pneumococcus empyema we found it difficult to remove this deposit without causing excessive trauma to the underlying lung. Such trauma is undesirable because it prevents the early application of Dakin's solution. In a few cases I made cross incisions of the pleura (Ransohoff) but have not noted any marked inflation of the lungs. In another series of cases I have merely curetted the fibrous deposit and believe that I have seen a more rapid formation of granulations.

The wound is simply packed and no sutures are introduced. At the first dressing from 4 to 6 days after operation the tampons are

removed and treatment with Dakin's solution is carried out until final healing occurs

2 *Treatment of chronic empyema sinuses* The chronic empyema sinuses may be divided into two classes (a) those that are sterile and (b) those that are infected

a Sterile sinuses heal permanently upon discontinuing all treatment. Only in rare instances does a reaccumulation of pus or serum occur

b Infected sinuses In the treatment of these it is absolutely necessary to find the reasons for the infection. The most frequent causes and their treatment are the following

a Accidentally lost foreign bodies such as sponges drainage tubes rubber dam etc

b Necrotic ribs

c Branch sinuses and irregular side pockets of the main sinus which can not be reached perfectly for an adequate treatment with Dakin's solution to permit sterilization these usually require a Schede operation for a perfect exposure

d Pleuropulmonary fistulas As already pointed out in a previous portion of my paper pleuropulmonary fistulas are very common most of them are small and heal quite readily and spontaneously during the acute stage. If not they are usually of large size and connect directly with a bronchus. The non healing is due to two conditions first because the bronchial epithelium has grown outward and lines the termination of the channel and second because the mouth of the sinus is continually held open by the dense fibrous deposit upon the visceral pleura. Their treatment is rather difficult. I have succeeded in most cases with the following procedure. An adequate exposure of the mouth of the sinus is an absolute essential and is readily obtained by means of a Schede operation. The lung is then very thoroughly mobilized at the margins of the cavity a step which in spite of the density of the adhesions is quite readily done and with some care without undue traumatization of the lung. This simple mobilization of the lung is I believe the most important part of the operation as it allows of approximation and healing of the margins of the fistula. In a few cases I have excised a small wedge shaped piece of the lung

surrounding the fistula and closed it by a few catgut sutures

The primary dressing of these cases is very important. I lay considerable stress upon the fact that no gauze should come in contact with the fistula. I dress these cases by interposing between the fistula and the gauze a sterilized piece of rubber dam. In many cases I have found the fistula closed at the first dressing 6 or 7 days later if not I employ dressings saturated with dichloramine T

3 and 4 *Pus collections at some distance from the original empyema and reaccumulations of pus in the original cavity* usually require costatectomy. An intercostal incision is in primary empyemata is insufficient because the healing of the first empyema has caused too much approximation of the ribs for adequate drainage

5 *The treatment of lung abscesses* opens up a chapter almost foreign to the theme under discussion. I shall mention only one important point namely that I believe that in these cases a simple adequate incision and drainage is sufficient and that owing to the already existing massive adhesions between the visceral and parietal pleura this is usually quite a simple procedure

6 *The treatment of bronchocutaneous fistulas* is a somewhat more difficult procedure. It requires adequate mobilization of the lung usually obtained by means of a Schede operation followed by excision of entire fistulous tract with or without subsequent suture

The objectionable feature of the treatment of all cases complicated with a pulmonary fistula except occasionally in the acute stage arises from the fact that they do not permit of treatment with Dakin's solution for self evident reasons. In these cases at least until the fistulous portion has closed I have used quite successfully dichloramine T in small quantities and have found it a good substitute though not as satisfactory as Dakin's solution

It is apparent that the subject of empyema is by no means as simple as it has hitherto been regarded. I have merely skimmed it superficially but I shall feel that I have been amply repaid for the preparation of this paper if I have stimulated further study of the many remaining unsolved problems



## EMPHYEMA

ANALYSIS OF 70 CASES AT BASE HOSPITAL CAMP JACKSON SOUTH CAROLINA

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AS in many of the other cantonments so at our hospital the subject of empyema has been one of the important surgical condition that has come up for consideration. Due to the frequency of its occurrence and its high mortality it has attracted considerable attention and the interest manifested in it has been enhanced by the widely different results that have been reported. The rapidly fatal outcome following early operation on a number of patients showed us that we were apparently dealing with a condition somewhat different from what we had ordinarily considered empyema at home and that therefore different treatment was required. Upon investigating more carefully it was found that we were confronted with two different conditions: one in empyema following the usual lobar pneumonia, the other following secondary pneumonia. The object of this paper is to demonstrate that the widely different results obtained and the various opinions expressed are due to this difference in cases. We will show that those cases following a primary pneumonia usually lobar in character and caused by the pneumococcus give results in the army hospitals as good as those obtained in civil life, while the empyema following secondary pneumonias is extremely severe and has a high mortality. We were not as some people believed dealing with a new disease but with conditions that are less frequent in civil practice. For instance measles which furnished a large number of pneumonias is rather infrequent in adult life under ordinary conditions or at least we do not see any large number of cases at one time but it is a common and severe disease in camp. Other diseases also such as tonsillitis, bronchitis and influenza are apt to be more virulent when occurring in epidemic form; they may be of streptococcal origin and the pneumonia following is often bilateral bronchopneumonia. It is these various groups that

have furnished our severe empyema cases with a high mortality. Our ideas in regard to the treatment of empyema following primary lobar pneumonia have not undergone changes but in regard to those following secondary pneumonia we have been impressed with the influence of the antecedent disease on the course and we have learned that the results obtained depend very much on the type of organism producing the infection and also on the procedure followed in treatment. Apparently there is a certain time when conservative method should be followed and a period when radical surgical method should be resorted to.

This paper is based on the study of 70 cases that have come to operation in the ten months period from November 1, 1917 to September 1, 1918 up to about the time of the influenza epidemic but not including any of the latter cases. The subject is presented from a surgical standpoint. No attempt will therefore be made to go into bacteriology or pathology in detail. During the early part of the period covered our laboratory was in a stage of development and was overwhelmed with a meningococcus sepsis epidemic. As a result bacteriological examinations of pneumonia and empyema cases were not made as frequently as is now the case. However a positive finding is present in most of the cases and in the few in whom none was made we have grouped a patient with the class of cases to whom he clinically corresponds.

The frequency of the disease in the different months of the period is illustrated by the accompanying chart which shows it to be most common in the winter months when acute respiratory diseases are at their height (Chart 1).

## ETIOLOGY

The statement is frequently made that men of the South are more prone to pneumonia and empyema than the Northerners and again

that those from rural districts are more often affected than those from urban districts. In a given camp this statement is difficult to prove or disprove. Our troops for instance were nearly all from Southern States and had led an outdoor life. It is only by a comparative study of the statistics from various camps available at the Surgeon General's Office that definite conclusions in this respect can be drawn. Of our 70 cases 64 or 91 per cent were from the Southern States and 52 or 74 per cent were farmers or laborers leading an outdoor life. Though many of our soldiers were former cotton mill workers who in appearance were rather poor physical specimens not one of our empyema patients was drawn from that class. The frequency of malaria and hookworm infection and the incidence of pellagra in the South have been cited as predisposing causes. Their role is a secondary one in that they lower the general resistance of the patient. Ten of our patients showed hookworm though not all had their faeces examined and two had malaria in a chronic form. It does not appear that the percentage of colored soldiers affected with empyema was higher than that of the whites. Of our 70 cases 57 were white and 13 colored.

In considering the exciting causes it is found that pneumonia preceded the empyema in nearly every case. Many of them were primary lobar pneumonias while the majority were secondary to some acute infectious condition.

These secondary pneumonias are divided as follows: 3 following measles, 7 bronchitis, 3 influenza, tonsillitis, 1 otitis media, 1 meningitis, 1 abscess of cheek, 1 tonsillectomy, 1 following an anæsthetic and 3 following typhoid inoculation.

The incidence of pneumonia following typhoid inoculations is of great interest. Patients usually state that they have had a cough which became aggravated immediately after the injection. The relation between typhoid inoculations and acute respiratory diseases merits investigation.

We had only three cases that were originally diagnosed as pleurisy. Whether they developed a pneumonic process before going on to empyema formation is doubtful. In these

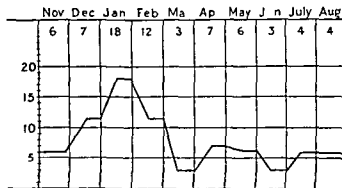


Chart 1

cases the question may well be raised whether there was not some lung focus present that ruptured externally and produced the empyema. Upon going into the history of these so called primary pleuritis it is found that they have not been well for some time that they have had a cough and a cold in the chest.

Among either groups of the above cited cases may be those with a general sepsis in which the localization in one or both lungs and a subsequent empyema are but manifestations of a general septic process. Other parts of the body may likewise be affected and play an important rôle in the course of the disease. They may even be the more important factor.

#### TYPES OF EMPYEMA

If one sees a large number of these patients he is struck with the fact that they differ a great deal. Some correspond more to the type which we have been accustomed to see in civil life, others are of a degree of severity that leads to a fatal issue in a short time. The noticeable fact attracting attention in many of the patients is the early formation of large amounts of fluid. This fluid is usually thin, dishwater like and contains flocculi of fibrin. Because they differ in their course and prognosis and in order to facilitate study and to bring out the essential differences between the various types of empyema we have divided them into those following: (1) primary pneumonia, (2) measles pneumonia, (3) other secondary pneumonias and (4) primary pleurisy.

Another classification based on the bacteriological findings allows us to group them into those caused by the pneumococcus and those caused by the streptococcus. Other varieties

of organism we did not encounter in our 70 cases. In the final analysis this classification is the more important one because when looking over the entire series it is found that cases due to the pneumococcus although more severe in the following a secondary than in the following a primary pneumonia give about uniformly good results while the prognosis in streptococcus infection is always grave and the complications many.

1. *Empyema following primary lobar pneumonia.* It is not always possible or at least not easy to differentiate strictly between primary and secondary pneumonia because at the time when empyema and pneumonia are most frequent very many people have some respiratory affliction. However we have put into this class all the cases of lobar pneumonia that had a sufficient net though some of the patients may have had a cough preceding it. Table I given below embraces 4 cases. The process involved either one or several lobes or even both sides in some cases simultaneously in others successively. With the exception of two cases one of which was due to the streptococcus the other to a mixed infection they were all caused by the pneumococcus.

It will be seen by looking over this table that fluid was usually found within two or three weeks after the onset of the pneumonia and that operation was performed as soon as the presence of pus was demonstrated. In five cases 6, 8, 9, 16 and 20 the empyema was of the small encapsulated variety. This accounted for the late finding of pus in two of them. One patient had been returned to duty. Case 16 apparently well and came back about three months after the onset of his pneumonia with a small encapsulated empyema apparently interlobar in character.

Complications in this group have been few. There were three patients with an otitis media. Cases 3, 11 and 14. Two patients Cases 12 and 13 had a parotitis that did not go on to suppuration. Pericarditis was diagnosed in Case 10 and was found at autopsy in Case 1. A few patients had superficial abscesses and one of them Case 11 had a large abscess of the rectus abdominals resembling a full bladder and another one of the back. The

former was sterile while the latter contained pneumococci.

Three cases of this group ended fatally. Case 15 had a positive blood culture of Type I pneumococcus. He died with symptoms suggesting meningitis. Case 18 died 11 days after the onset of his disease and one day after operation. During the latter pockets were broken up with the aid of the finger and it is possible that this had something to do with the fatal outcome. The fact that it occurred so soon after would indicate this. It certainly does not seem wise to carry on extensive manipulations when operating for empyema especially not early in the disease. An autopsy was not performed in these cases.

Case 19 died of a streptococcus sepsis 11 days after the onset of his pneumonia. Autopsy revealed consolidation of the entire left lung and an extensive pericarditis with serosanguinous effusion.

It may be stated that empyema following primary lobar pneumonia which attacks the patient while in good health not weakened by antecedent disease usually runs a shorter course than the other varieties. In the list given in Table I the average length of time from admission to the hospital until the patient returned to duty was 2 to 3 months. The few patients who were confined a long time had extensive secondary operations performed. They will be described in detail further on.

*Empyema following measles pneumonia.* These cases have been put into a class by themselves because they are usually very sick and the mortality is higher than in the other varieties. The group comprises 3 cases 17 of which had a broncho and 6 a lobar pneumonia preceding the empyema. Thirteen cases were caused by the pneumococcus and ten by the streptococcus (Table II).

The complications in this group have been many and in a few cases they have contributed toward a fatal outcome. Ten patients developed a suppurative otitis media two of them bilateral. We encountered several superficial abscesses and one deep abscess of the rectus abdominals. There was one extensive cellulitis of the back taking its origin from the empyema wound and another one of the neck leading to suppuration and rupture into the

pharynx. There was one patient with a peritonitis and one with a non suppurative proctitis. Patient 35 deserves special mention. He was first taken sick on November 21, 1917 with mumps. On December 19, 1917 he developed measles and on the 22d a bilateral bronchopneumonia. The following day symptoms of meningitis manifested themselves. These two diseases pneumonia and meningitis then ran their course. For the latter he received intraspinal and intravenous injections as practiced at this camp leading to a complete cure. The pneumonia became complicated by a right sided empyema showing a pure culture of streptococci. In spite of this he made a good recovery and was returned to duty March 31, 4 months after the onset of the mumps.

The mortality was high for in 9 patients or 30 per cent a fatal outcome is recorded. All of these cases had a bronchopneumonia, 6 due to the streptococcus and 3 due to pneumococcus. It will be noted that 6 of the patients who died were operated on early from 5 to 9 days after the onset of the pneumonia. Of the 3 who died after a late operation 2 had extensive lesions and really succumbed to a general sepsis. Those who died after an early operation died very promptly, one on the day of the operation, 3 on the following day, 1 two and 1 four days later. This to us has seemed of some significance and we have tried to discover the reasons for it which will be considered somewhat in detail under treatment.

Case 4 had a double bronchopneumonia, left empyema and pericarditis with effusion.

The course has usually been a long one for regardless of the time following the onset of the measles or pneumonia the average stay of patients in the hospital was  $3\frac{1}{2}$  to  $4\frac{1}{2}$  months.

Altogether it must be said that measles pneumonia is an extremely severe disease. Several of the patients had been discharged to duty after measles and were returned with a pneumonia. Others were sent on long journeys before they were well. The frequency of pneumonia in patients so treated would indicate that exposure has a great deal to do with its development after measles. To

guard against it therefore and in order to prevent empyema patients should be put to bed early. They should be kept warm and well protected and in the hospital long enough to be sure of complete cure.

3. *Empyema following other secondary pneumonias.* This group of 6 cases includes all those patients who developed empyema secondary to pneumonia following upon some other acute infection aside from measles. Simple cough we have not considered as an etiological factor but rather those conditions that made the patient sick and were then followed by a pneumonia. The reason is that the vitality of these people is frequently undermined and the pneumonia developing is more apt to be bronchopneumonia and frequently is bilateral in character. Of this series fourteen followed lobar and 6 bronchopneumonia. Fourteen were due to the pneumococcus, 4 to the streptococcus and 2 were mixed infections of both these types.

It will be seen in surveying Table III that the course of the disease varied considerably. Some patients recovered promptly while others had a prolonged convalescence necessitating a stay in the hospital of from 4 to 5 months. The complications were not many but they were extremely severe and contributed considerably to the fatal terminations. Of the four streptococcus cases the only one who recovered was one treated by repeated aspirations and late operation. Another one, Case 48 treated in the same way, was doing well and was apparently on the road to recovery when he developed a suppurative peritonitis and a general sepsis and died. Both patients with a mixed infection died. Of this series 7 cases ended fatally.

The autopsy records of 5 of them are given below.

CASE 50. Lobar pneumonia, bilateral pleuritis, right 400 cubic centimeters of fluid, empyema, left old tuberculosis, right apex, luteic aortitis, luteic cirrhosis of liver, fibrous perisplenitis.

CASE 51. Empyema, right, cornification of right lung, numerous abscesses of body, acute endocarditis, infarcts of spleen and infarcts of kidneys.

CASE 52. Pyopneumothorax, right, abscess of right lung, pneumonia, right lung.

CASE 60. Lobar pneumonia, left, encapsulated pus pocket, left, due to perforation of lung abscess, empyema, left.

CASE 62 Empyema right pleura left pneumonia left upper and right lower lobes thorax involved

4 *Empyema following primary pleurisy*  
We had only 3 patients who can be put into this class. That a condition exists in which the pleural involvement is apparently the chief factor must be conceded. These 3 patients had not been well for some time before the intrathoracic condition assumed alarm proportions and made them seek medical aid. When they came under observation they were very sick and prostrated.

CASE 63 Illustrates a type in which there is apparently a transition from the pleura and a secondary pneumonia of the lung. Eight days after the onset of pleurisy and after a rather benign course there is a change and ten pulmonary abscesses in turn are filled by empyema.

CASE 64 As noted in the history of the acute onset of pneumonia and dyspnea and chest filled with thin turbid fluid. An exploratory puncture was made and pus was obtained. The pus was sent to the laboratory and an acute pneumonia was diagnosed. The patient died from the edges of the pus. The lungs were pathologically hyperemic. The diagnosis of the pneumonia was confirmed by the culture of the pus. The patient died from day to day. Whether the cause of death was the pneumonia or the pus is not clear. The patient died from the pus. The patient died from the pus.

#### DIAGNOSIS

Though according to textbooks the detection of fluid in the thoracic cavity should be quite easy it is by no means always that. It is by the careful examination of the chest done daily and recorded on the chart that the presence of fluid is first suspected. By this systematic work the variation in signs from the previous day or days will be noted. Displacements of the heart are of great value. By having had the patient under observation for some time one is familiar with the organism causing the infection and can be on the lookout. It is important that the presence of large amounts of fluid be detected early and that it be submitted to bacteriological examination because one is guided in the treatment largely by the laboratory findings. It is interesting with what rapidity the fluid sometimes develop. However at times all physical signs fail and it is familiar to those

who do much of this work how deceptive signs may be. It is probably not putting it too strongly when we state that fluid in the chest may give the exact physical signs of a pneumonia and *vice versa*. Therefore when a suspicion of fluid exists whether early in the disease or because the lung condition does not clear up as promptly as it should one should never hesitate to use the aspirating needle. If properly introduced no harm can result. It should be of sufficient length and caliber and be introduced attached to the syringe with the piston pushed down. In this way the entrance of air is prevented. There is no place of selection for the exploration it must be done wherever the fluid is suspected.

If these means fail the X-ray has proved of great value particularly in the smaller encapsulated varieties of empyema. In doubtful cases therefore an X-ray should be made preferably a stereoscopic and if a focus is found exploratory puncture should be done under guidance of the plate. The fact that two of our patients, Cases 16 and 67 were sent to duty after their pneumonia and later returned for an encapsulated empyema might suggest that all pneumonia patients should be X-rayed before being discharged.

#### CLINICAL CONSIDERATIONS

In order to treat empyema intelligently and to get the best results it is essential that the physiology and the mechanics of respiration be understood. We must know what happens if a normal pleural cavity is incised and left open. A condition of so called open pneumothorax will ensue which means air will enter from without and in time cause the lungs to collapse. In addition to that this now positive pressure in the pleura will force the mediastinum over to the other side and embarrass thereby not only the respiration but also the circulation. It is for this reason that an open pneumothorax is so much feared on the battlefield.

Now these factors play a rôle and an important one in the treatment of empyema. To appreciate this properly we must visualize to ourselves what an empyema really is. Is it to be considered a collection of pus only or the residue of an inflammatory process in

other words a simple abscess or is it an exudation fluid accompanying an acute inflammation and existing simultaneously with it? The answer to this is that it may be either at the time that we are called to see a patient and it is up to us to determine which it is for on that depends the treatment. In the former case when it is simply an abscess of the pleura surrounded by an abscess wall the treatment is manifestly quite simple for incision followed by evacuation of the pus will give prompt relief and no embarrassment of the respiration will ensue. On the other hand if the fluid present is accompanying an active inflammatory process of the pleura and the underlying lung the conditions are entirely different. No protective abscess wall has formed no or few adhesions are present and if such a thorax is opened we are confronted with all the dangers of an open pneumothorax. The fluid will of course be evacuated but its place is promptly taken by air and this air representing a positive pressure will bring about collapse of the uninvolved lung and produce displacement of the mediastinum. The question then arises how are we to apply this knowledge to the treatment of an individual case? In order to do that we must know certain other facts. Clinical observation and studies at the autopsy table have taught us that pneumococcus infections of the pleura have a tendency to form pus early and that this pus becomes walled off early. We further know that in a pneumococcus lobar pneumonia the pleural involvement is usually confined to the involved portion of the lung. In a pneumococcus bronchopneumonia the conditions are somewhat different but the general characteristics of the organism remain the same. In these cases therefore operation is indicated as soon as the presence of pus is demonstrated.

In streptococcus infection of the lung with secondary pleural involvement on the other hand conditions are different. The entire pleural layer both visceral and parietal often becomes involved very rapidly and a profuse exudation of serum takes place. There is no early tendency to walling off and no protective barriers have formed. This extensive involvement is partly due to the fact that many

of the streptococcus pneumonias are secondary pneumonias they are usually bronchopneumonias with various small foci scattered throughout the lung causing a secondary involvement of each overlying portion of the pleura. Suppuration of this fluid meaning by that a change to actual pus occurs rather late often only after several weeks have passed. However with the change of fluid to real pus protective barriers form and it is then safe to operate.

Aside from the danger of pneumothorax there is one other very important factor that must constantly be borne in mind namely the condition of the lungs at the time that operation is contemplated. This applies to the lung of the infected side as well as that of the opposite side. These patients are all very sick and we must be careful not to do anything that will aggravate their condition. Opening a thorax while the pneumonia is still active will increase the strain on both the respiration and circulation. Here again there is a marked difference between the two varieties of infections. We know that pneumococcus lobar pneumonia usually runs a short course. When we are therefore called in to see such a case on the tenth or fourteenth day we know that the pneumonia has probably cleared up and if pus is found we know it is safe to proceed with the operation. With a pneumococcus bronchopneumonia a little more care is necessary and it may be well at times to postpone the operation a few days perhaps doing an aspiration in the meantime.

In the streptococcus pneumonias we usually find numerous foci of infection one may clear up while another forms. Several lobes or even both sides may be affected simultaneously or successively. Opening such a thorax will diminish the patient's chance of recovery for a pneumothorax will form as stated above and there will be collapse of all uninvolved portions of the lung. And as frequently the other side is also partly involved we increase the strain instead of decreasing it.

What then can be done to benefit these patients what is the correct procedure to give them the best chance for recovery? Unfortunately some of these patients seem doomed from the beginning they are simply over

come by the everty of the infection and there is nothing known to us at present that will save them. The first temptation is to operate at once. As a matter of fact that was the procedure we followed at first until the promptly fatal results in a number of cases pointed that out as the wrong treatment. Heroes are apparently not in place with this work and it requires almost that to operate on patients in that condition. They are in great distress as a result of sepsis, the involvement of the lung, the embarrassed circulation and the presence of the fluid. Operating on such a patient will relieve the septic fluid but nothing else. It will not improve the lung condition or the circulation quite the contrary, it will bring about the collapse of the uninvolved lung to succumb on the affected side and force the mediastinum over to the already overburdened other side. This to our mind accounts for the rapidly fatal result in some of the cases given in the tables.

The one object gained by operation, namely the removal of the fluid, can be obtained by aspiration without the danger attending an early operation. This treatment suggested itself to us early in the period covered and though followed hesitatingly at first we have gradually become more convinced of its efficiency and now apply it in all properly selected cases. Aspirations are repeated as often as indicated, sometimes only one or two are done, then again several depending on the case. As soon as the fluid becomes suppurative indicating thereby that adhesions are forming or have formed, and we feel reasonably sure that the pneumonia has subsided we operate. No matter which organism is responsible for the infection, the aim should be not to operate while the pneumonia is active.

It is only when considering the accumulated amount of septic fluid in the chest as the principal factor in the disease that an early operation seems indicated. There are apparently those cases that are swamped with a streptococcus infection and its chief or only localization is in the pleural sac. In such a case removal of the fluid by early operation is perhaps the only chance a patient has and one should go ahead fearlessly. However, even in

the cases complete aspiration may produce as good results without the dangers attending an operation. It is a question whether the lung is ever involved in such a condition. Patient 10 belongs to this class. To prevent the pneumothorax one may use any one of the method of closed bottle drainage. The great objection to them is that they are cumbersome, easily deranged and contribute to the discomfort of the patient. During the early days after operation however a Brewster tube with a negative pressure bottle system does excellent service.

Though operation is delayed in the type of cases outlined above, one should not wait until a thickened pleura has formed favoring chronic cavity formation later on. The old rule to evacuate pus as soon as formed applies here also. Each case must be judged on its own merits, there is no absolutely fixed rule but the considerations outlined above should guide us to reach a decision in a given case. If called in therefore to see a patient with a view to operating we must come to a conclusion after considering his general appearance, his present temperature and pulse, the antecedent disease, the length of time since the onset of pneumonia, the type of fluid found and the organism producing the infection.

#### SURGICAL TREATMENT

It must be borne in mind that in a military hospital where changes in the staff are frequent it is difficult to control all detail of treatment. However, a certain uniformity of opinion has prevailed especially in regard to the time of operation.

In very sick patients we have done and continue to do an intercostal incision frequently in bed and without removing the patient to the operating room. Novocaine in 1 per cent strength is used and the incision is made just long enough to allow the introduction of drainage tubes. Whenever the condition of the patient allows it, which is usually the case, he is taken to the operating room and rib resection is done. In only two patients has ether been used. All others were operated upon under local anesthesia using 1 per cent novocaine. We have used either one large fluted tube or a double drainage tube. There

seems to be no difference in the reaction or the result. The tubes should be just long enough to insure a free flow but not so long as to impinge against the lungs. A large pad and firm binder are applied and the patient is encouraged to rest on the operated side. We were not in the habit of washing out but large masses of fibrin were removed at the time of operation. In the latter part of the period covered we began to use Dakin Carrel treatment quite extensively and would introduce the tubes either at the time of operation or on the following day. In the words we use Gatch bed frames which allow a Fowler position. They contribute greatly to the comfort of the patient. In the first days following an operation we use morphine in sufficient amount to overcome the distress and severe dyspnea. There is one complete dressing a day at which time the cavity is irrigated and the tubes cleaned or changed. Outer pads are changed as necessary. At the time of dressing the patient's back also receives attention his skin is thoroughly cleaned and an alcohol rub given.

In regard to the use of antiseptic solutions we have used everything from normal saline boric acid cherry red iodine and peroxide to Dakin's solution. When looking over our entire series it is impossible to state truthfully that any one method has yielded uniformly good results. Dakin treatment was used faithfully and in the hands of men taught at the Rockefeller Institute. In some cases it was used early beginning on the day of operation. In the older cases later to help clean them up. We obtained very good results in some cases but had equally good results in some parallel cases in which nothing but simple drainage was used. Any very striking results showing marked superiority over other methods were not observed. Two of the cases treated with Dakin solution and closed with secondary suture when the wound was apparently sterile had to be reopened. Attention must be called to the fact that though the cavity does apparently become sterile as evidenced by a clear mucoid discharge pus may be situated in some dependent portion of the cavity and the irrigating fluid is prevented from acting on it by the presence

of this mucoid covering. It is therefore important that the position of the patient be changed from time to time especially that it is changed during the irrigation. All patients operated upon since September 1, 1918 have at once been put on Dakin treatment and it is being continued until a cure is obtained. None of those cases are included in this series. They will be reported upon at a later date.

From our observations the most important points in the treatment both in order to get a cure and to get an early cure are to drain at the most dependent part in order to prevent collections of pus from forming and to keep this drainage opening sufficiently wide to allow free drainage. As healing progresses not the caliber of the tube but rather its length should be reduced for this very reason viz to get good drainage a rib resection is preferable to an intercostal incision.

It is also important to encourage deep breathing and light arm exercise. To prevent reinfection of the cavity the fistulous opening and the surrounding skin must be kept scrupulously clean. An occasional application of iodine to the former is of benefit.

The length of time from the onset of pneumonia to the discharge of the patient or from the time of the operation until the wound was closed varied so much that no clue was found which would guide us to get a uniformly good result in a very short time. So many factors enter in and materially influence the course of the disease.

As will be noted from a perusal of the attached tables the duration of the disease was usually shortest in those cases of empyema following primary lobar pneumonia of pneumococcus origin.

The remarks about treatment are incomplete without calling attention to the importance of diet. The patients are usually in poor physical condition when they come to the surgeon and their emaciation increases rapidly as suppuration continues. We have been very fortunate in having the full cooperation of the administrative personnel in the treatment of these patients. Anything that was procurable has been obtained for them. In addition to their regular meals they



would receive milk raw eggs etc at two hour intervals and in that way we have succeeded in keeping up their strength to enable them better to overcome the infection

All empyema patients are kept in a special ward or wards depending on the number in the hospital at any one time They occupy beds on the sunny side in order to have the benefit of the sunlight The temperature is kept comfortable we do not believe that very cold air is of benefit As soon as we feel it is safe for the patients to be up we encourage them to sit up in a chair for a short time every day By means of the Gitch springs they have become accustomed to the sitting posture and the transition from that to out of bed is easy for them

#### SECONDARY OPERATIONS

In empyema one is by no means always dealing with a single cavity and the main cavity may have several smaller pockets communicating with it With the existing tendency to walling off one of these pockets may become partially or entirely shut off from the main cavity Such a condition is favored by inadequate drainage We have repeatedly observed secondary pus pockets break spontaneously and empty through the thoracic fistula In other cases we have aided such a rupture by the introduction of a dressing for cep In some cases it became necessary to enlarge the drainage opening by simple stretching and in four patients Cases 53 57 64 and 13 in whom a primary intercostal incision had been done a secondary rib resection had to be performed

In one case No 10 who had a persistent fistula leading to a deep seated small cavity we resected two ribs under local anæsthesia mobilized the lung excised the fistula and cleaned out the cavity Immediate Dakin treatment was started flushing the wound every two hour After a week the tubing was removed and the cavity allowed to close There was no communication with a bronchus and the treatment was well borne

In three cases we had to do an extensive rib resection with decortication of the lung On account of the interest attaching to the condition we shall report them in detail

CASE 5 was first operated upon October 2 1917 a part of the eighth rib being resected On account of profuse drainage which did not diminish he was again operated upon January 28 1918 and the 5th and 6th ribs were resected for the greater part of their length The thickened pleura was incised in several places to allow expansion of the lung The patient's condition was so poor that extensive decortication could not be done The drainage diminished but did not cease before a counter incision was made anteriorly February 4 1918 He improved considerably but as he complained of pain in the chest and did not gain as rapidly as he should an X ray was made It revealed an encapsulated empyema higher up This was drained on April by resecting part of the 5th rib anteiorly Recovery was uneventful after that He returned to duty July 16 1918

The importance of the X ray in the diagnosis of empyema is not fully appreciated by us in the beginning It is not used by us not only in the original diagnosis whenever doubt exists or we want to localize a pocket exactly but it is also used to follow up the case after operation Whenever a patient is not doing well and physical signs fail we resort to the X ray with most gratifying results

CASE 68 An intercostal incision was made for empyema on October 21 1917 Drainage continued practically therefore the cavity was injected with bismuth and an X ray plate was made It showed a cavity extending up at the suprascapular space Operation January 9 1918 excision of six inches of the eighth seventh sixth fifth and fourth ribs and a part of the third rib The thickened pleura and the costal surface of the diaphragm were stripped off the lung and the pericardium carried through the section upward to the dome of the thorax The lung collapsed after resection of the cavity The cavity was closed February 2 1918 and the patient returned to duty March 16 1918

CASE 1 Opeation as done October 4 1917 for right empyema An intercostal incision was made The patient was extremely ill During the course of his disease he developed acute necrosis of the suprascapular area The entire bony alar process was ectatic in a slight time leaving a opening into thetrum on the side The intermaxillary bone did not slough away and was later used for the attachment of plate The empyema showed no tendency to heal Bismuth paste was injected and revealed a large cavity extending up to the clavicle Operation January 4 1918 through large curved flap excision The skin perforator was removed and the ribs were pushed up and a drainage tube was placed about 4 inches of the fifth and fourth ribs 3 inches of the third and inch of the second rib were then resected The thickened parietal pleura and intercostal muscle forming the anterior wall of the cavity were removed The pleura which was 4 inch thick was removed The skin of the pleura was then stripped off the lung which

expanded as soon as released. A small gauze strip was inserted into the cavity and the wound was then closed. The patient reacted well. After operation there was some bloody, frothy expectoration but no other untoward result. Convalescence was slow. He was returned to duty June 21, 1918.

There was only one lung abscess in this entire series that came to operation. He deserves mention.

**CASE 24.** The diagnosis was made by puncture obtaining the same foul smelling material which he was expectorating. It was confirmed by the X ray. The odor was so offensive that isolation became necessary. The abscess was secondary to lobar pneumonia due to pneumococcus type 2 which began 14 days before the abscess was recognized. The exploring needle withdrew air and foul smelling thick pus. The X ray showed a lobulated cavity of the upper portion of the right lower lobe surrounded by an area of infiltrations. Operation July 13, 1918, resection of 3 inches of the seventh and eighth ribs under local anesthesia. Parietal pleura separated from chest wall to mobilize it. Exploratory punctures were then done and when the abscess was entered the needle was left in place. A circular silk suture was then inserted at a distance of 1 inch from the needle suturing the visceral to the parietal pleura. A narrow bladed knife was then placed alongside the needle into the cavity and the opening widened so soon as pus was obtained. After cleaning out the cavity a gauze strip and rubber tube were inserted and another gauze strip was placed between the chest wall and the parietal pleura in order to keep them separated.

Recovery was uneventful. Dakin treatment was not borne well on account of a communication between the cavity and a bronchus. Iodoform gauze was therefore used in packing. The patient improved rapidly as the discharge diminished. It became necessary later to remove the silk suture. Recovery was complete and the patient was returned to duty November 13, 1918.

#### PROGNOSIS AND FINAL RESULTS

Enough has been said in the presentation of the various groups to indicate that empyema is a serious condition and that its development after pneumonia requires thorough study before operation is resorted to. This is especially true of the streptococcus infections. The pa-

tients are usually in poor condition as the result of the preceding infection and their resistance is low so that any additional strain may determine a fatal outcome. Some patients seem simply doomed from the beginning and any measures known to us at present are without avail. We must therefore be very careful not to do anything that will diminish their chances of recovery.

It should be borne in mind however that though some of the deaths are attributed to empyema because it was the condition for which the patient was operated upon, other lesions of a general sepsis or the lung condition itself was really more responsible.

Taking the various groups once more and studying them in relation to the final results we find there were

Following primary pneumonia 4 cases with 3 deaths or 12 per cent.

Following measles pneumonia 23 cases with 9 deaths or 39 per cent.

Following other secondary pneumonias 20 cases with 7 deaths or 35 per cent.

Following primary pleurisy 3 cases with no deaths.

If we classify the cases according to the organism producing the infection instead of according to antecedent disease we find that there were

54 pneumococcus cases with 9 deaths or 17 per cent.

16 streptococcus cases with 10 deaths or 62 per cent.

Taking our total of 70 cases we find that there were

19 deaths or 27 per cent, 48 cured or 69 per cent and 3 in the hospital, or 4 per cent.

The three patients remaining in the hospital are doing well and promise to go on to complete recovery so that the total will be 73 per cent cured.

All patients listed as cured have been returned to duty. This includes those patients with extensive rib resection.



TABLE I—CASES OF EMPYEMA FOLLOWING PRIMARY LOBAR PNEUMONIA—Continued

| N m   | R | O t f<br>P n | O s<br>E | A p n t                           | O p t  | S d | Type F l d | T m<br>O | Res l t         | T i t m |
|-------|---|--------------|----------|-----------------------------------|--------|-----|------------|----------|-----------------|---------|
| 3 W J | W | Dec.         | P eum    | D 3 3 m<br>J 4 5 m<br>J 8 46 gu m | J      | L   | P          | d y      | C M d d ty<br>6 | m       |
| 4 K W | W | J            | P m      | J ly f l p                        | J ly 3 | R   | Pus        | d y      | C N d d ty<br>1 | 4 m     |

TABLE II—CASES OF EMPYEMA FOLLOWING MEASLES PNEUMONIA

| Nam      | R | O t f<br>Meas | O t f<br>P eum na | Type | O an m | A p t  | O p t  | S d | Type F l d  | T m<br>O s t<br>P n m na | C m p l t na                                    | C ty l sed | R ult                 |
|----------|---|---------------|-------------------|------|--------|--|--------|-----|-------------|--------------------------|---|------------|-----------------------|
| 5 A J W  | W | D             | D 4               | B    | St pt  | D 6  | Dec 6  | L   | P           | 3 d ys?                  | g l h   |            | D d<br>Dec 7          |
| 6 A W G  | W | J 7           | J 4               | Lob  | P um   | J —p   | J 4    | R   | P           | d y                      | O t t m d                                       | Ap 6       | C d<br>d ty<br>Ap 8   |
| 7 A H B  | W | M y 6         | J 3               | B    | St pt  | J l 5—5 m<br>dy fl d                             | J 5    | L   | Th<br>p m 5 | d y                      | O t t m dia                                     | N          | J h<br>d g<br>ll      |
| 8 C H M  | W | N 7           | D 7               | Bro  | P m    | Dec fl d<br>J 3—p                                | J 3    | R   | P           | 7 d y                    | N   | F b 8      | C d<br>d ty<br>M 5    |
| 9 C J C  | W | D 3           | D                 | B    | St pt  | J th 54 m<br>fl d p rul t                        | J 4    | R   | P           | 4 d y                    | O t t m d<br>S p p t<br>pe l r y g t<br>d t h t |            | D d<br>J              |
| 3 C J W  | W | J 5           | F b<br>Ap 9       | B B  | P m m  | Ap l 3—1<br>Ap l 4—oo<br>m th t<br>b d           | Ap 4   | R   | Th<br>p     | 5 d y                    | O t t m d<br>A t ph t                           |            | D d<br>Ap 8           |
| 3 D W    | W | N             | D                 | B    | P m    | D 6—th p<br>D 2—th k<br>p                        | D 4    | R   | P           | 4 d y                    | O t t med                                       | F b 5      | C d<br>d ty<br>F b 9  |
| 3 D L A  | W | N 5           | D 3               | Lob  | P m    | D —p   | Dec 5  | L   | P           | d y                      | O t t m d                                       | F b 8      | C d<br>d ty<br>M 5    |
| 33 G H   | C | Ap 4          | M y 4             | L b  | P m    | M y 9—1 dy<br>fl d<br>J ly 7—3 m<br>p            | J ly 7 | L   | P           | 44 days                  | N   | A g 9      | C d<br>d ty<br>S pt   |
| 34 H W A | W | Oct 4         | N 4               | B    | St pt  | N 3—600<br>l t p                                 | D      | R   | S<br>p l t  | 8 d y                    | O t t m d                                       |            | D d<br>Dec 4          |
| 35 H C   | W | D 9           | D                 | B    | St pt  | J fl d<br>F b 5—p p o-<br>p m h                  | F b 6  | R   | P           | 35 d y                   | M m gloc<br>g ius<br>M l t f l J t<br>llings    | M 8        | C red<br>d ty<br>M 3  |
| 36 J W   | W | Dec 8         | Dec 7             | B    | St pt  | J l 8—p ru<br>m<br>J t fluid<br>J 7—p y<br>p m h | J 7    | R   | P           | 3 d y                    | O t t m dia b l<br>Absces<br>b l Ab t<br>lec    | M M 3<br>3 | C d<br>d ty<br>M ty 9 |
| 37 K T   | W | N 3           | Dec 5             | Lob  | P m    | D 7—thin<br>p<br>F e c                           | Dec 3  | L   | P           | 5 days                   | N   | Ap 7       | C d<br>d ty<br>Ap 9   |

TABLE II—CASES OF EMPYEMA FOLLOWING MEASLES PNEUMONIA—Continued

| N          | R     | O s f<br>M d k | O s f<br>I m a | T <sub>1</sub> | O m             | A                         | O <sub>r</sub> | S      | Type (F) | T <sub>m</sub><br>O s f<br>I m a  | C m p l | C y l e d | R u l             |
|------------|-------|----------------|----------------|----------------|-----------------|---------------------------|----------------|--------|----------|---|---------|-----------|-------------------|
| O B        | W J   | F b            | I              | P m            | F b<br>F b<br>P | I d<br>I d<br>I d         | F b 6          | R P    | d y      | O media b l<br>A b o c e s f t o e<br>C l l a h i b l<br>P G (2)<br>I e p s |         |           | D d<br>M b        |
| P H        | W N   | N              | I              | S i            | N               | N                         | N 9            | R Th P | 8 d y    | N   |         |           | D d<br>N          |
| P L E      | W N   | N              | I              | S i            | N               | N                         | N              | R Th P | d y      | N   |         |           | D d<br>N          |
| I J E      | W N   | D              | I              | S i            | D<br>I d        | —                         | J              | R P    | y day    | N   |         | M 3       | C d<br>M y 6      |
| P A        | W J   | F i            | B              |                | F i<br>F b<br>m | g - I J<br>I<br>I d d d d | F b            | R Cl d | d y      | A b i m l d<br>t  |         |           | D d<br>F b 5      |
| R S A      | W N   | N              | P              | P m            | Dec<br>m        | —<br>o o<br>I d           | J              | L I    | day      | N   |         | Mar       | C d<br>d y<br>M   |
| T J        | W M y | M              | I              | P m            | M               |                           | M g            | L P    | d y      | O m d   |         |           | D d<br>M y 8      |
| V A<br>T B | W N   | I              | B              | P m            | J               | —                         | J              | L P    | 8 d y    | P p r a   |         | M         | C d<br>d y<br>M 9 |
| W H W      | W N   | N              | L b            | P m            | D               | 6 - p                     | J              | L P    | 8 d      | N   |         | F b       | C d<br>d y<br>M 5 |
| W A L      | W N   | I              | I b            | P m            | J               | 6 -<br>r u l<br>m m       | J              | L P    | d y      | N   |         | M         | C d<br>d y<br>M 8 |

TABLE III—CASES OF EMPYEMA FOLLOWING OTHER SECONDARY PNEUMONIAS

| Name    | R | A <sup>sc</sup><br>I <sup>sc</sup> | Q <sup>a</sup><br>I <sup>m</sup> | T   | m           | A <sup>m</sup>                                     | C <sup>r</sup>                              | d     | T <sup>m</sup> (F l d) | T <sup>m</sup><br>I <sup>m</sup><br>m <sup>na</sup> | Cmpl  | Res                                      |                   |              |
|---------|---|------------------------------------|----------------------------------|-----|-------------|--|---|-------|------------------------|---|-------|--|-------------------|--------------|
| s G G   | W | I fl za                            | F b                              | Lob | St          | F b —<br>F b 6—<br>F b 9—<br>F b 5—<br>F b —       | —<br>8<br>m m m<br>—<br>6<br>m              | F b 3 | L                      | P   | days  | P  | D d<br>Mar h      |              |
| L B     | W | I fl                               | J s                              | L b | S           | J —<br>F b —<br>F b —<br>F b 6—<br>F b 8—<br>F b — | —<br>8<br>80<br>5<br>5<br>6<br>m m m<br>m p | F b 3 | R                      | P   | 6 da  | N  | C red<br>d<br>J s |              |
| s W P W | W | I fl za                            | M                                | Lob | P um        | M y —<br>M 6—                                      | cl s f d<br>cloudy fl d                     | M 3   | L                      | P   | 9 d y | B l t<br>m i l l                         | D ed<br>M         |              |
| s A H A | W | B h                                | J 8                              | B   | St<br>P d m | J o—<br>f b —<br>bloody fl d                       | o—<br>800<br>m fluid                        | F b 5 | R                      | com<br>bi d<br>fluid                                | 8 d y | P M 1 l j<br>Phl b l f m<br>C flud l eck | p l               | D d<br>f b s |
| s H C H | W | B h                                | J                                | B   | S           | J —thin p  |   | J 5   | R                      | Th<br>P   | 4 day | N  | D d<br>J s        |              |

TABLE III—CASES OF EMPYEMA FOLLOWING OTHER SECONDARY PNEUMONIAS—Continued

| E        | R | A t d t<br>Dy             | O t<br>um | Typ   | O g m             | A t<br>t  | Ope t  | S l | Typ f l d           | T m<br>O s e t<br>p m | Compl t         | R lt                  |
|----------|---|---------------------------|-----------|-------|-------------------|---|--------|-----|---------------------|-----------------------|-----------------|-----------------------|
| 53 J R C | W | B h t                     | D 6       | B     | I m               | J 4-<br>9-p                                       | J 3    | R   | P                   | 4 d y                 | N               | C d<br>d ty<br>3p     |
| 54 M H G | W | B h t                     | Dec 9     | L b   | P m               | J 4-<br>p m<br>3-p                                | J 8    | L   | P                   | 3 d y                 | N               | C d<br>M 9            |
| 55 M C O | W | B h t                     | M         | L b   | P m               | M 3-<br>5-cl<br>dy fl d                           | M 5    | R   | S g<br>fl d         | 4 d y                 | E 3 p l f       | C d<br>d ty<br>M y 5  |
| 56 O H   | C | B h t                     | M 8       | Lob   | P m               | Ap 1 9-p  | Ap 9   | R   | P                   | d y                   | N               | C d<br>d ty<br>A g 4  |
| 57 P G   | C | B h t                     | J 8       | Lob   | I m               | J 3 -p  | J 3    | R   | P                   | day                   | B h a l f t l a | C d<br>d ty<br>J ly 8 |
| 58 M C J | W | T l l t                   | D 8       | Lob   | P m               | Dec 6-P   | J      | R   | I                   | 5 day                 | N               | C d<br>d ty<br>Ap 8   |
| 59 P C T | W | T l l t                   | Ap 3      | Lob   | I m               | Ap 1 5-se<br>Ap 1 8-p                             | Ap 8   | R   | P                   | 5 day                 | N               | C d<br>d ty<br>J 3    |
| 6 G M C  | W | T l l t e t m y           | J 3       | B     | St pt             | F b 4-<br>F b 5-700<br>I b 6-560<br>I t -5<br>b d | I b 3  | L   | Th<br>t b d<br>fl l | 4 d y                 | P l d t<br>m th | D l<br>F b 6          |
| 6 D A    | C | A h k f                   | J 7       | Lob   | P m               | J p -5 m th                                       | J      | R   | Th<br>p             | 5 l y                 | N               | C d<br>d ty<br>p t    |
| 6 M B    | W | O t t m l<br>j m t d      | Ap        | Lob   | St pt<br>d m<br>P | Ap 18-bl l m                                      | Ap 8   | R   | Bloody<br>m         | 6 d y                 | M t d l t h m   | D l<br>Ap 19          |
| 63 R V   | C | A æ th                    | M 8       | L b   | P m               | M 7-t b d fl l                                    | M 7    | R   | Th<br>p             | 9 d y                 | N               | C l<br>d ty<br>J ly 6 |
| 6 J L    | W | M g t                     | Ap 7      | Lobar | P m               | Ap 3-<br>Ap 9-py p m                              | Ap 3   | R   | P                   | 3 d y                 | N               | C d<br>d ty<br>A g    |
| 65 D I   | W | A t typh d<br>I o c l a t | M y 7     | B     | P m               | M y 8-th p  | M y 8  | L   | Th<br>p             | d y                   | P r d t         | D d<br>M y            |
| 66 H E   | W | A t typh l<br>I o c l t   | Ap 8      | B     | P m               | Ap 6-<br>Ap 1 dy fl l<br>dy fl d m                | Ap     | R   | Th<br>p             | 3 d y                 | P l t d r y     | C d<br>d ty<br>A g 6  |
| 67 W H   | C | A yph d<br>I o c l t      | J 4       | L b   | P m               | J ly -p   | J ly 3 | R   | P                   | 9 d y                 | N               | C l<br>d y<br>A 9     |

TABLE IV—EMPYEMA FOLLOWING PRIMARY PLEURISY

| N m      | R | O t   | A t t             | Ope t | Type fl d     | S d | O g m             | R lt            |
|----------|---|-------|-------------------|-------|---------------|-----|-------------------|-----------------|
| 68 D H B | W | Oct 8 | Oc -p             | Oct   | P             | L   | I m o c o c       | C l<br>d ty M 6 |
| 69 R R M | W | M y 8 | J -1<br>J m h r a | J 7   | P             | R   | P m o c o c       | C d<br>d y 4    |
| V G E    | W | F l   | F b 3-t l i f l   | I l 3 | T b d<br>fl l | R   | St p t o c o c u. | C d<br>d y M    |

## A REVIEW OF THE TREATMENT OF PURULENT PLEURITIS (EMPHYEMA) AT CAMP PIKE BASE HOSPITAL

B I T N T VICTOR P DIETRICH M C U S A  
h f f h F y m a s B H l m P k A k a

THE following report is based on experience of nine months in the treatment of purulent pleuritis embracing the months of March to December and includes 147 cases. It covers not only three seasons which are of importance in discussing this condition but also includes the pleuritis following three distinct types of primary infection which are even more important namely influenza followed by hemolytic streptococcus or pneumococcus pneumonia measles followed by hemolytic streptococcus or pneumococcus pneumonia or primary lobar or bronchopneumonia caused by the pneumococcus or hemolytic streptococcus or both.

The course and outcome of purulent pleuritis are most assuredly dependent to a very large extent upon the antecedent infection and for this reason it is important to remember that the surgical treatment of this condition is often a secondary matter.

The term empyema certainly has played a large and often dangerous part in the selection of various types of surgical intervention in the treatment of purulent pleuritis. It has been a most misleading term because of the fact that many cases of purulent pleuritis encountered during the past year have not answered the description generally under too often empyema.

A review of the literature of the past brings forth two principal types of treatment:

1. Open method either by rib resection or intercostal thoracotomy with permanent drainage.

Closed method by repeated aspirations.

The open method with resection of one or more ribs was and is recommended by some. The method was modified by various men for the improvement of drainage and production of negative pressure such as the siphon pump, Brewer tube, rubber suction bulb, rubber flaps to cover outlet of tube allowing

egress but no ingress of air into the pleural cavity.

A method used in Europe and to some extent in this country was the introduction of a catheter as a means of aspirating the pleural cavity. Irrigations were considered dangerous and seldom used until lately.

The closed method with frequent paracentesis and aspirations was recommended by some and Murphy advised the injection of 1 per cent formalin in glycerine after aspiration as a means of sterilizing the pleural cavity and aiding absorption of the exudate.

The subject of treatment as discussed in textbooks as a rule consisted of a description of one or more types of operations these usually being emphasized while little or no reference was made to the type of infection or the stage of the disease with the exception of the last stages when decortication, thoracoplasty or bismuth paste injection were recommended. This condition persisted up to the present year and even now we find reports in various journals where the treatment recommended consists of rib resection, aspiration, aspiration with rib resections later and catheter drainage by means of one or more catheters some advising irrigations and others not. This most striking difference in method apparently with often almost equally good result must not be surely be dependent on some common factor the result of selected cases or else a coincidence.

The object of this paper therefore is an attempt to analyze the reason for this apparent difference in method with equally good result and apparent similarity of method with strikingly different results with a view of establishing a clear conception of when one method should be used and when another.

The following statistics are compiled in a three month period therefore covering the

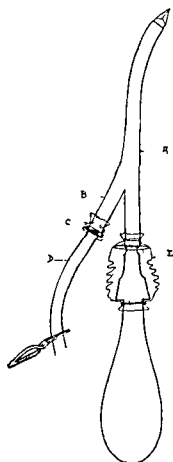


Fig 1 Diagram and photograph of trocar catheter cannula. A Common shank of cannula B catheter or tube shank of cannula C cap made of three layers of dental dam with small perforation in center to admit tube

tightly D tube—standard Carrel Dakin tubing—clamped shut E thin rubber tube or condom tied over handle of trocar and outlet of cannula making an airtight connection

various seasons and also three distinct main types of primary infection as mentioned above. They include 225 cases. Of this number 147 came under my care during their entire course while 78 who had been admitted to the empyema ward during the months of January and February include 30 who died before March 1 and 48 on whom I did the postoperative dressings.

#### JANUARY AND FEBRUARY SERIES

This series in which I took no part in the treatment except the later after treatment includes the cases occurring during the severe winter months when patients were kept indoors when the hemolytic streptococcus infection was most virulent and measles was a frequent primary infection. Because an entirely different method of treatment was employed in this series from that which was used in the later cases I am including this series for comparison.

|                              |    |    |   |
|------------------------------|----|----|---|
| During the month of January  |    | P  | t |
| Number of cases admitted     | 63 |    |   |
| Deaths                       | 30 | 47 | 6 |
| Method of treatment          |    |    |   |
| Rib resection                | 63 |    |   |
| Deaths                       | 30 | 47 | 6 |
| During the month of February |    |    |   |
| Number of cases admitted     | 15 |    |   |
| Deaths                       | 1  |    |   |
| Method of treatment          |    |    |   |
| Rib resections               | 13 |    |   |
| Deaths                       | 1  | 6  | 9 |
| Aspirations                  |    |    |   |
| Deaths                       | 0  |    |   |

#### MARCH, APRIL AND MAY

The majority of cases admitted during March and April were suffering from a hemolytic streptococcus infection and many were still suffering from an active pneumonia. They were also handicapped in so far as climatic conditions were unfavorable. Until the latter part of March all cases were kept indoors.



T car thoracotomy  
 C thete aspirati n and irrigat n 8 Per t  
 Deaths 0

## JUNE JULY AND AUGUST

The cases admitted during these months with a very few exceptions had primary lobar or bronchopneumonia. They were usually men who had been in camp for several months and consequently hardened and in better condition than those in the preceding series. The weather conditions were all favorable.

During the months of June July and

August  
 Number of cases admitted 18  
 Deaths 0  
 Method of treatment  
 Thoracotomy with catheter  
 Irrigation and irrigation 13  
 Deaths 0

SEPTEMBER OCTOBER AND NOVEMBER  
(Influenza Period)

This period was undoubtedly the most severe. The majority of the patients had passed through an attack of the influenza which was followed usually by bronchopneumonia sometimes lobar pneumonia and often both. They entered the empyema ward as a rule still suffering from an active pneumonia not infrequently bilateral. Of this series 9 per cent had a bilateral empyema.

During the month of September October

and November  
 Number of cases admitted 83  
 Deaths 7

Method of treatment  
 Aspiration 3489  
 Death 6  
 Thoracotomy 14

Bilateral cases  
 Number of cases 83  
 Deaths 20 27

Culture of pleural fluid in 100 cases  
 Hemolytic type occurred 3  
 Hemolytic type occurred 1  
 Pneumococcus type in 1  
 Number of cultures 88  
 Streptococcus hemolytic 44 50  
 Streptococcus non-hemolytic 34  
 Streptococcus and pneumococcus 23 68  
 Streptococcus and diphtheria 2

During the month of June July and August  
 Number of cases admitted 18  
 Deaths 0  
 Method of treatment  
 Aspiration 13  
 Death 0  
 Thoracotomy with catheter  
 Irrigation and irrigation 13  
 Deaths 0  
 During the month of September October and November  
 Number of cases admitted 83  
 Deaths 7  
 Method of treatment  
 Aspiration 3489  
 Death 6  
 Thoracotomy 14  
 Bilateral cases  
 Number of cases 83  
 Deaths 20 27  
 Culture of pleural fluid in 100 cases  
 Hemolytic type occurred 3  
 Hemolytic type occurred 1  
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 Streptococcus hemolytic 44 50  
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 Streptococcus and pneumococcus 23 68  
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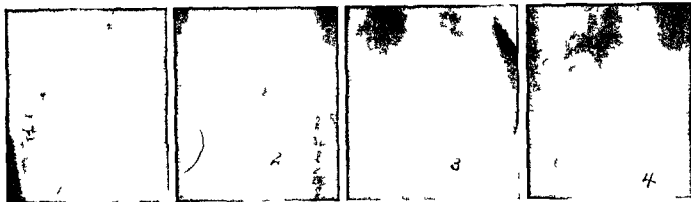


FIG. 3. Case 51. Midpleural empyema (1 ft). 1 Patient lying on breast. X-ray of empyema between inner surface of left lung and mediastinum. Note resemblance to shadow of purulent pericarditis or effusion. The right edge on left side differentiates it from a precardial affair which would be bowl shaped. Late al-

view. Same case showing that just extended posteriorly thus enveloping root of lung. This also helps to differentiate it from a precardial affair. 3 Patient lying on back shows tube in situ. It has been inserted anteriorly. 4 Patient lying on breast. View showing patient after he had entirely recovered. Compare this case with Fig. 4.

|                                     | P  | T     |
|-------------------------------------|----|-------|
| Pneumococcus                        | 27 | 29 51 |
| Type I                              |    | 1 13  |
| Type II                             |    | 3 40  |
| Type IIa                            |    | 4 54  |
| Type III                            |    | 0 5   |
| Type IV                             |    | 3 40  |
| Undetermined                        |    | 9 00  |
| Pneumococcus and influenza bacillus |    | 1 13  |

Resections total 94 37 deaths or 39.7 per cent  
 Aspirations total 34 14 deaths or 41.1 per cent  
 Trocar catheter total 9 7 deaths or 77.8 per cent

An analysis of the above four series of cases brings out the following very interesting results which in some respects are apparently very contradictory both here as well as to the results obtained at other camps.

During the months of January and February 1918 at Camp Pike practically all cases of purulent pleuritis were treated by primary rib resection. From what I saw of the latter part of this series during the month of March I would say that it was the rule to do a rib resection as soon as fluid was found in the pleural cavity providing it contained organisms irrespective of whether it was serofibrinous seropurulent or purulent. It was classed as empyema and treated according to the textbook teaching for this condition.

During the month of January 65 cases were admitted and 50 died a mortality of 47.6 per cent. In February 15 cases were admitted and one died. Here in two successive months we have two series of cases both

treated by the same method. One with a mortality of 47.6 per cent and the other with a mortality of 6.6 per cent. No irrigations were used.

Had the results of February been used as a criterion resection would probably have been recommended. Four times as many cases were admitted in January as February. In March the mortality rose again to 35.7 per cent and dropped to 6.2 per cent in April however in April the treatment was changed to that used at the present time namely trocar catheter with Dakin's irrigations. It is fair to assume that during January the virulence of the infection was at its height and the majority had an active hemolytic streptococcus pneumonia when they entered the empyema ward. The drop in the number of cases in February would lead one to suppose that the epidemic was on the decline. The majority of these cases were patients who had recovered from their pneumonia or had pneumococcus infections while the earlier ones were mostly hemolytic streptococcus infections.

The same effect can be seen in the results obtained by other methods. During the month of April May June July and August when no severe epidemic or pneumonia existed in camp the mortality by the trocar cannula method was nil in a series of 54 cases. It would have undoubtedly been higher had this same number of cases been treated in January and February. This was

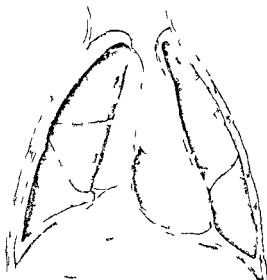


Fig 4. Sketch of lungs showing the location of the trocar cannula method of aspiration.

shown in the recent influenza epidemic of October and November when out of 61 cases treated by the trocar cannula method the mortality was 11.47 per cent a marked increase in death rate over the summer months and yet much better than 47.6 per cent by the resection method used in January, February and March. This point is again emphasized by the mortality of 48 per cent in 7 cases who were aspirated during the influenza period.

A word might be said here regarding the high mortality of the cases aspirated. Some have recommended the aspiration method. Results have been published which were excellent so far as low mortality is concerned. Our experience at this camp has been that although aspirations in the early stages should be done in the great majority of cases it will be necessary to do a thoracotomy later and to irrigate the empyema cavity.

The mortality of 41.1 per cent in cases who had merely been aspirated during the recent epidemic means that those were cases who were still suffering from an active pneumonia. They were referred to the empyema service because fluid containing organisms had been found. At autopsy these cases

showed not only an active pneumonia but very frequently scrofulous or seropurulent fluid was found at aspiration or autopsy in quantities insufficient to have caused death.

A small percentage of those cases aspirated repeatedly preparatory to insertion of a tube by means of a trocar and cannula recovered before it became necessary to use a tube.

In view of the above facts we may say therefore that the status of the aspiration method is that it is to be used as a preliminary method in those cases with serofibrinous or seropurulent fluid when pneumonia often is still present and adhesions have not formed to wall off the empyema cavity and attach the lung about the abscess cavity to the chest wall. After these adhesions have formed by which time the fluid is purulent irrigations can be used and pneumothorax if produced is limited to the abscess cavity. Collapse of large portions of the lung is thereby avoided an important factor especially at the time when there is little healthy functioning lung tissue present. Also by this means a small percentage of cases will recover without further surgical intervention.

The use of 1 per cent formalin in glycerine after aspirations was tried in three cases before we began using the trocar cannula method. In my opinion the method offers little improvement over the simple aspiration method. Thoracotomy must be resorted to later and convalescence of the patient unnecessarily prolonged with the exception of that small percentage of cases who get well without resorting to anything after simple aspirations have been done.

Primary rib resection especially in the virulent hemolytic streptococcus and pneumococcus infection as seen in the recent epidemic will I am sure be condemned when its results of last winter are compared with those obtained by the combined aspiration and trocar catheter method used at this camp.

Looking at the statistics from April to December we find that 95 cases have been treated by this method with 7 deaths or a mortality of 7.05 per cent. Results which would compare favorably with the best feel



Fig 5 Empyema patient being irrigated

would be the same series of cases treated by the method as outlined by the Empyema Commission at Camp Lee last spring

They recommend aspiration followed by rib resection and irrigation with Dakin's solution. They recommend resection on the ground that the good surgical principle of free drainage should be used once the empyema cavity has been walled off.

I have had no experience with this method inasmuch as those cases with rib resections last spring who were irrigated with Dakin's solution had not had preliminary aspirations. The results with the trocar catheter method however have been too good to wish trying anything else.

The average length of time elapsing between the thoracotomy and the closure of the chest was 40 days. From present indications this time will be considerably shortened in the present series. The rapidity of closure is greatly dependent upon the thoroughness in which irrigations and aspirations are done and with over 50 cases to be irrigated from 4 to 8 times in 24 hours it is easy to see that organization and sufficient help are important factors in the management of these cases.

The treatment is carried out in the following manner:

After a diagnosis of pleural effusion has been made the pleural cavity is aspirated with a syringe and the specimen sent to the laboratory. Those cases who are still suffering from pneumonia and are in a critical condition are not moved from the medical ward until one or two aspirations have been made. In the meantime a report has been made



Fig 6 Convalescent empyema patient. Small scar one inch below and three inches posteriorly to left nipple was the site of thoracotomy. Note expansion of patient's chest.

from the laboratory giving the type of organism in the fluid. Those cases with hemolytic streptococcus are sent to the streptococcus empyema ward and those with pneumococcus are sent to the pneumococcus ward. All cases in these wards are kept on the porches.

The frequency of aspirations is dependent on the rapidity with which fluid reaccumulates. In the hemolytic streptococcus cases while the fluid is serofibrinous it accumulates very rapidly. Often two and occasionally four aspirations are necessary in 24 hours. This is especially true if there is a pneumonia or purulent bronchitis present on the opposite side when every bit of available lung tissue is necessary. In the course of a week or ten days the fluid accumulates slowly at which time aspirations are done every third or fourth day. In the hemolytic streptococcus cases the fluid now becomes thick and creamy in consistency and is usually of a slightly greenish tinge. Aspiration by means of a needle even of large caliber becomes difficult and it is then time to do a trocar thoracotomy. In cases of bilateral empyema aspirations are continued even longer.

In the meantime stereoscopic X-ray pictures have been taken one or more times and a definite idea obtained as to the extent and character of the cavity. The progress of the

patient is often stormy during the period and as mentioned before pneumonia is usually present during this time. There is usually a marked improvement following each aspiration.

#### TROCAR THORACOTOMY

The principle upon which I have based the trocar thoracotomy technique is that of preventing ingress but allowing outlet of air from the pleural cavity.

The matter of allowing air into the pleural cavity is not a serious one after the empyema cavity has become walled off and yet I feel that in those instances especially with rib resections where there is a continuous rush of air in and out of the cavity patients do not do as well as they should.

Any method of drainage through the chest wall is bound to leak air after a few days. This method however prevents leakage of air for a week and often much longer and even after that it acts as a valve allowing the air to escape freely but allowing very little to enter.

The location and limits of the cavity having been established a site for the thoracotomy is selected. It is unnecessary to select the most dependent portion of the cavity as the tube passes to the bottom of it. If possible a site is selected near the anterior axillary line. This is done because the heavy muscles of the back are avoided thereby reducing discomfort and pain from the tube and dressing. The wound is also kept in better condition.

With 5 per cent procaine and adrenalin dermal, subcutaneous and intercostal anesthesia is produced at the site of operation. The skin is then punctured with the point of a scalpel sufficiently to allow a snug passage of the trocar. This puncture wound is made at least one inch below the upper border of the rib or in other words over the interspace below the one to be punctured. The trocar and cannula with a tube inserted (Fig. 1) are then passed through the puncture wound and upward over the outer surface of the rib until it reaches the upper margin of the rib. When the upper margin of the rib is reached the tip of the trocar is pointed inward and

hugging the upper margin of the rib closely thereby avoiding the intercostal vessels it is forced into the cavity.

The trocar is then withdrawn from the cannula sufficiently to allow the Dakin tube which is held in the extra arm of the cannula (see Fig. 2) to be pushed into the cavity. The rubber fitting about the outer ends of the cannula prevent any air from entering the pleural cavity about the trocar or tube. The outer end of the tube has been clamped before and when it has been inserted deep enough into the cavity the cannula is withdrawn over it. The tube is then clamped near its entrance into the skin thereby allowing the clamp to be removed from the outer end when the cannula can be slipped off from the tube entirely.

A 50 cubic centimeter Leurgan syringe is then attached to the tube and the cavity aspirated. The cavity is then irrigated with normal saline solution. If the patient does not cough Dakin's solution is used. Only a very few cubic centimeters are injected at first. This is done because of the fact that occasionally there is a pulmonary fistula connecting with the cavity through a ruptured subpleural rib cecus. In this case the Dakin solution enters the lung and a severe attack of coughing is caused. If this be the case the solution is discontinued and salt solution or no irrigations are used. This condition however is not very common and irrigations with Dakin's solution are continued until the fluid returns clear. When the syringe is detached the tube is always clamped thereby allowing no air to enter the pleural cavity.

The tube is attached to the skin by means of two linen threads fastened to the skin with adhesive. The tube is then passed through a 10-inch square cotton pad. This is covered with another and the ends are held in place by adhesive.

Patients are irrigated with Dakin's solution from 6 to 8 times in 4 hours. Irrigations may be done by removing only the outer pad. Each irrigation is continued until the solution returns perfectly clear. A small quantity 5 to 10 cubic centimeters is allowed to remain in the cavity.

The use of Dakin's solution to irrigate these cavities is undoubtedly of great value. In those cases however with pulmonary fistula Dakin's solution can not be used. Even a few cubic centimeters passed into such cases is sufficient to set up a severe attack of coughing and the patient will say usually that he feels as if he were being strangled. In these cases the cavity is irrigated with salt solution and the patient is made to lie on the side involved.

We have used optochin (ethylhydrocuprein) in 1 per cent solution in pneumococcus cases especially in those who have pulmonary fistula. Results have been better than where salt solution was used but not as good as in those cases where Dakin's solution was used.

A few days after thoracotomy has been done patients are given blow bottles. The amount of this exercise is controlled entirely by the patient's condition. At the end of two weeks at which time the patient is usually in good condition he is blowing the bottles from eight to fifteen times daily. That is he has emptied from eight to fifteen gallons of water during the day. From X ray controls we have found that these exercises undoubtedly aid in the expansion of the lungs. After a few days of irrigation the fluid from the cavity becomes clear somewhat gelatinous and then mucilaginous in character.

A specimen is then taken in the morning and sent to the laboratory for a smear count. When the fluid shows no organisms by smear count a culture count is made. If this is negative on two successive days after no Dakin's solution has been left in the cavity for eight hours the thoracotomy wound is closed.

The patient is taken to the operating room and thoroughly irrigated with Dakin's solution. Under local anesthesia the fistula is excised very easily. This is done to decrease any danger of contamination of the cavity from infection which might result from the fistula.

Blowing the bottles is discontinued for five days the two silk worm sutures are then removed and in a few days the patient begins his blowing exercises again.

#### NUTRITION

An important factor is the nutrition of these patients. Every effort is made to keep the nutrition up to the very highest point. They are fed frequently. Besides their regular meals they are given egg nogs, milk, ice cream or cocoa between meals.

Another important factor is the keeping up of the morale and consequently a good appetite of these patients. Constant attention to those things which make them happy and comfortable is very necessary. First of all in cold weather it is important to be constantly on the watch to see that they are well blanketed. Games and music by means of a Victrola were supplied occasionally. Above all a discussion of cases either by nurses and officers in the presence of patients was never tolerated. Another point which is so often overlooked. Whenever a patient entered a ward *in extremis* and the prognosis was grave he was not put in a small room inside because he was expected to die but was put on the end porch with plenty of fresh air but isolated from the other patients. It is remarkable what effect one death in a ward has on the morale of the patients. When patients were convalescing they spent part of their time folding dressings and reclaiming washed gauze. Another point which adds greatly to their comfort and for which they are probably most thankful is regular shaving and a haircut. Convalescents were used for this purpose. In other words the ward was made a happy community every one helped his neighbor and the result was happy patients with a good appetite.

The only control of their metabolism was their general condition and weight. They were weighed regularly every week. Gains as high as eight pounds a week have been recorded.

After patients were strong enough to take exercise they were put in classes and given breathing exercises twice daily. They have all left the hospital in the best of health and spirit some weighing more than ever before and pictures of health.

Of the series treated during the early summer months I have found by correspondence that they are feeling very well and there

have been no recurrences. Of those cases on whom resections were done five have recurred to my knowledge.

#### SUMMARY AND CONCLUSIONS

Summing up the subject of empyema as I have seen it at Camp Pike Base Hospital I would say that it together with pneumonia is the condition demanding the most attention and care. The cases have come usually in waves and at times when the hospital was severely taxed both for help and space. The waves have followed epidemics such as measles and influenza which had undermined the health of the men.

Under conditions such as these the factor which was of vital importance was organization in other words team work. With the ever changing personnel this was doubly necessary with vigilance both day and night.

*Prophylaxis* Nothing probably has been so thoroughly proven relative to this subject as the importance of crossed infections in pneumonia empyema both during their primary infection as well as later.

Therefore all hemolytic streptococcus infections as well as carriers should be isolated. If not pneumococcus cases may develop hemolytic streptococcus pneumonias. The same is true of pneumococcus cases of different types. They should be separated so that a type II pneumococcus does not contract a type IV pneumococcus pneumonia *et cetera*. If this is carried out in the contagious wards the percentage of hemolytic streptococcus pneumonias and purulent pleuritis will certainly be extremely small.

#### TREATMENT

The treatment of purulent pleuritis resolves itself into two phases the *early phase* when pneumonia is still present and when the presence of infected fluid in the pleural cavity is only a menace when in quantities large enough to embarrass respirations or heart action by displacing the thoracic viscera. A small quantity of fluid may be of benefit to the inflamed pleura by separating it and also splinting the lung. During this stage aspirations should be done. They should be done with the greatest care to

avoid injuring the lung and producing a pneumothorax.

In my estimation aspiration increases to some extent the formation of pockets but this even is of less danger than an early pneumothorax whereby the lung is often completely collapsed. If pockets are produced they can be easily taken care of by the trocar cannula method.

*The late stage* When the fluid has become distinctly purulent and as mentioned above the pus has become walled off it is time to do the trocar thoracotomy. This should be done according to the technique as described above.

Blowing against positive pressure with the blow bottles is of distinct value in aiding the expansion of the lungs.

Patients must be kept out of doors and warmly clothed.

Nutrition is highly important. Hemolytic streptococcal cases become emaciated very rapidly. Keeping them in a happy frame of mind improves their appetites and hastens their convalescence.

*Dental hygiene* Care of the teeth and mouth was insisted upon.

*Medication* Digitalis was not used. In cases of failing heart action ice bags were placed over the precordium and camphorated oil given subcutaneously.

Glucose in a 25 per cent solution was given intravenously in those cases entering the wards with a pneumonia and showing signs of dehydration and acidosis. This solution as well as normal saline was prepared in 500 cubic centimeters Erlenmeyer flasks. This method is very simple, rapid and a distinct improvement over many others. Two hundred and fifty cubic centimeters were given in one hour and this repeated in 12 hours until the patient showed considerable improvement and was taking sufficiently of liquids by mouth.

*Liquids* Patients were required to take liquids in the form of water, milk and lemonade very freely especially during the early stages.

*Tonics* Iron, quinine and strychnine were given in all cases to improve their appetite.

*Exercises* After the wounds were closed and the patients were well along to convalescence they were put in classes and given breathing and setting up exercises twice daily which was gradually increased. They were then also given light ward duties such as looking after the blow bottles shaving *et cetera*

#### CONCLUSIONS

Constant attention and the very best of care are absolutely necessary on the part of the doctor nurses and corpsmen to get good results in the treatment of purulent pleuritis

The trocar cannula thoracotomy followed by the insertion of the Dakin Carrel tube according to the method I have described affords the following advantages

1 The operation is very simple and can be done with the patient in bed as easily as can a paracentesis (see Fig 5)

2 If done properly no air enters the pleural cavity for several days

3 Because of the flap valve character of the opening air passes from the pleural cavity much easier than it enters consequently

there is a continuous automatic production of negative pressure in the cavity at least relative if not absolute as compared with the normal

4 Dressings are never soiled and therefore they give the patient very little discomfort

5 In cases with multiple pockets and pus in inaccessible places it is very advantageous (see Figs 3 and 4)

6 There is no resultant deformity of the chest (see Fig 6)

7 Convalescence is rapid and no recurrence has occurred

Dakin's solution is of distinct value both for its antiseptic properties as well as solvent action in these cases. It not only dissolves the exudate but aids the expansion of the lung by quickly removing the heavy plaques of fibrin from the pleural surface and preventing a fibrous thickening of the pleura

*Note*—The tube may be attached to a combined suction and irrigating apparatus

Since this report was submitted twelve more cases have been treated by the trocar cannula method with excellent results

## OBSERVATIONS ON EMPYEMA

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THERE is no subject of more importance for the consideration of the profession at this time than that of empyema. The virulence and extent of the epidemic of the past winter with its high ratio of incidence and excessive mortality at the height of the epidemic make it a problem not only for the army but for the civil population as well.

It has been the experience of most surgeons in civil practice that patients suffering from empyema usually get well and the problem has not been to obtain recovery from the immediate illness but to prevent the condition from becoming chronic and resulting in a persistent fistula. This to some extent has been due to the fact that in civil practice

these patients come to the surgeon after they have passed through an attack of pneumonia and attention has been called to the pleurisy by the persistence of the fever and the respiratory distress. The physical signs at this time conclusively show the presence of fluid in the thorax and no great diagnostic acumen is needed to determine the presence of pus. In thoroughly equipped hospitals and particularly those of the army where every laboratory facility is afforded the diagnosis is made so promptly that the fluid in the chest may scarcely show a discoloration from the presence of the pus producing organisms. Because of this fact there has been a tendency to open the chest or begin other surgical



measures immediately while the pneumonic process has not completely subsided. The natural result of this early intervention has been a high rate of mortality so high in fact that it is far above that seen in civil practice prior to the present epidemic. The early intervention however does not entirely explain the high mortality for in civil hospitals there has also been an increase in the death rate from this affection. In fact some of the patients come into the hospital with a purulent peritonitis in addition to an empyema pericarditis is a not infrequent accompaniment and a few cases may show small multiple furuncles in the skin endocarditis arthritis or otitis media and in some where this is not the case the patient is immediately overwhelmed.

It is necessary therefore to look further for an explanation of the severity of the infection. A particular form of organism first suggests itself as a cause but the bacterial flora found were streptococci pneumococci and staphylococci — well known strains of pathogenic organisms. There were found in these cases however a preponderance of the type of streptococcus which has the power of producing hemolysis the streptococcus hemolyticus which seemed to have an unusually toxic effect. The mixed types were also found to produce particularly severe results. In the latter part of the epidemic there seemed to be a considerable diminution in the virulence of the infective organism the streptococcus hemolyticus at this time being no more virulent apparently than other forms. This at least was my observation as I recall five cases occurring in the late spring in which this organism was found without mortality.

It is not fair to compare the high death rate in the early weeks of the epidemic or at its height with that of its decline since all epidemics end by such a decline in the virulence of the infective organism. It is fair however to compare two methods of treatment when applied side by side and also when one plan has a persistently high mortality and another employed immediately and almost coincidentally shows a very low death rate or none at all.

When I was first placed in charge of the

empyema ward at Camp Sherman the mortality was depressingly high notwithstanding the fact that one of the approved methods of treatment was being employed. This was so noticeable that I asked myself the question whether it was as good as the plan so long in vogue in civil practice. Up to this time aspiration repeated at intervals had been tried and abandoned thoracotomy with the employment of Carrel-Dakin fluid being the method then used. It is but fair to say that there was a slight but not material difference in the technique from that which I had observed at the Rockefeller Institute in that two tubes large enough to admit in the lumen of each a Carrel tube were inserted through a thoracotomy wound and through the latter the antiseptic solution was instilled. In every other detail the treatment was as directed at the Rockefeller Institute. These patients did fairly well for several days the amount of the discharge was lessened and no appreciable odor was found about the ward. The bacterial count apparently was diminishing from day to day but it seldom remained low long enough for one to feel safe in attempting to close the chest wound. I saw several wounds closed in from nine to twelve days at the Rockefeller Institute with apparent success. The fluid was checked properly and carefully by the laboratory force so that its strength and alkalinity were known to be all that could be desired. Notwithstanding this fact a number of these patients who apparently had been doing fairly well began to show gradual protrusion slight irritation about the wound which appeared as a brawny glazed toughened skin and a thickened dry pleura. The secretion from the chest was greatly diminished and in a short time ceased entirely. It was found that only by the immediate discontinuance of the treatment could the irritation be checked. If the treatment was continued these patients became weaker suffered from nausea pain in the chest vomiting with a temperature normal or slightly subnormal finally dying in exhaustion. In similar cases where the treatment was immediately discontinued on the first sign of irritation recovery followed. These results induced the conclusion that the use of a 2

per cent solution of formalin in glycerine a method which had been employed for some years in old cases of empyema would be more efficacious than the Carrel Dakin fluid and it was at once substituted.

The results following the change of treatment were very striking to those who had not been familiar with this method. It had been employed by us so long and with such satisfactory results that we pictured just what it would do. The mortality promptly fell from over 50 per cent to 5 per cent a remarkable difference. With this result it was no difficult matter for us to have the old method of John B. Murphy tried, consisting in the removal by thoracentesis of the pus from the pleural cavity and through the same syringe to insert one ounce of glycerine and formalin. This is readily accomplished without pain or much distress and should be repeated every third or fourth day until the fluid is perfectly clear and sterile.

To one not familiar with the change resulting from this simple treatment the result is spectacular. After the first treatment there is an immediate change in the color of the fluid and a very small amount of pus collects at the bottom of a test tube in which collected on the second treatment the fluid becomes clear but rather deeply pink and usually after the third treatment the fluid is a clear yellow sterile fluid. The quantity shows a gradual reduction and although there is immediately after the injection an increase of fluid in the chest it is rapidly diminished by absorption.

The advantages of this method are very apparent even to the most casual observer. There is no necessity of an open wound and with care the slight danger from tapping need not be considered; the recovery is more rapid than by any other method and it does not leave the chest impaired because the affection does not become chronic and pleural adhesions do not cripple the lung.

There are one or two other points worthy of mention. First the solution must be made the day before it is used because it takes eighteen hours for solution of the formalin in the glycerin and if the injection is made into the pleura when there is a connection between the cavity and a bronchus a very distressing

cough will be excited. The patients so treated begin at once to show improvement their appetite becomes voracious and they take on flesh. If the bronchus communicates with the pus cavity simple tapping may be employed or an open operation done since cough and dyspnoea are excited by fluid entering the bronchus.

A most simple method of applying an antiseptic to the chest cavity has been devised by Captain A. E. Mozingo who had charge of the empyema ward at the Walter Reed General Hospital during and prior to my service there. This consists of a stab wound made in the eighth interspace just large enough to admit a small drainage tube. After the tube is inserted the chest is freed of its fluid by means of a suction syringe and negative pressure. The tube is fastened to the chest wall by a safety pin and kept closed by a serrefine. Captain Mozingo developed this method to employ Carrel Dakin fluid which was instilled every two hours left for fifteen minutes and then withdrawn the pleural cavity being kept under negative pressure. I consider this to be one of the best methods offered for the application of any antiseptic but suggested to Captain Mozingo that a large trocar carrying a small catheter through its lumen would make the installation of the tube even simpler and do away with repeated aspirations and the pain etc. incident thereto.

Some patients remain in the hospital as long as one hundred and twenty days under the Carrel Dakin method which allows the disease to become chronic a condition that can be avoided by the formalin method. Particularly is this true where the method of Murphy is successful since these cases are relieved so promptly that there is but little opportunity for pocketing of pus by formation of adhesions. Graduated breathing exercises will materially aid in the expansion of the lung. This is a valuable measure also where the open operative procedure has been employed.

I wish particularly to emphasize the necessity to use every effort to avoid chronicity and sinus formation. After satisfactory drainage is established the lung should expand promptly and when it fails to do so after

suppuration is checked by formalin and the fluid become clear then prompt and radical measures are indicated. Only by the prompt adoption of such plan can these patients be brought to a recovery within a reasonable time. Some of them will recover with a chest greatly crippled and these are the cases in which treatment has been delayed. Such patients at this latter class rarely make soldier fit for full duty. Many of those treated early and properly may be promptly brought to a duty status that is within three to six weeks. *One running a long as two to four months are always more or less crippled in their respiratory function.*

It would be unwise to leave this subject without placing emphasis upon the fact that some cases are fatal from the inception of the disease. All serous membranes may be involved and the patient die of an overwhelming toxemia for which neither medical nor surgical skill offers at present any satisfactory remedy. It is doubtful if in the presence of pericarditis, peritonitis and empyema combined anything more in an operative way is justifiable than aspiration followed by the injection of formalin and in some of these cases where the toxemia is terrific it may be well to defer this measure until the patient adjusts himself somewhat to the combat. Certain it is that distressing dyspnea or cardiac distress is sufficient reason for aspiration which must be done slowly and with care in these serious cases. It should not be repeated with such frequency as to tax the patient's strength or to deplete him because of the loss of large amounts of fluid. No matter how carefully done there is always the possibility of contamination of a simple pleural effusion.

The open operation has one advantage in suppurative pleurisy and that is in the ready removal of the large masses of fibrinous lymph so often seen. This is particularly the case where rib resection is done. The Carrel-Dakin fluid also will probably remove this lymph because of its solvent action upon animal structures. It has seemed to us possible that this solvent action after the lymph was removed continued in a destructive way upon the pleura itself. It is an established

fact that it acts in this way on the peritoneal structures. We were not permitted by autopsy finally to determine this point but hope to do so experimentally when the occasion permits. In some chronic cases where the Carrel-Dakin method had failed and subsequently formalin had been ineffectual it was evident that pus pockets and a rigid lung existed and rib resection was necessary. This step should be undertaken as soon as it is evident that healing will not occur without it.

My observation of over one hundred cases in army hospitals leads me to recommend the following as the most satisfactory plan of treatment yet offered.

1. Diagnostic tap as soon as the presence of fluid is suspected. This should not be repeated with unnecessary frequency owing to the likelihood of the development of empyema. If the fluid is at all cloudy an injection of one ounce of a 2 per cent formalin solution is advisable at this time. A culture of the fluid begun before injection.

If there is evidence of pus in the chest cavity aspiration with the injection of one ounce of a 2 per cent formalin and glycerine should be made. This solution should stand for 24 hours before use because it takes sixteen hours for a complete solution. This injection should be repeated every third day until the pleural fluid having been removed prior to the injection. Care should be observed that the aspirator needle is in the pleural sac otherwise considerable pain will result from injection into the soft tissues of the chest wall. Within a week this method will usually clear up the purulent condition and with the assistance of breathing exercises will promptly restore the patient to a duty status. The great advantage of this method which was first proposed by John B. Murphy lies in the fact that the condition does not become chronic and therefore the lung does not remain collapsed but distends to fill the chest cavity as the clear serum remounting after treatment is absorbed.

3. Failure to clear up the pus by this method may be followed by open operation either thoracotomy or costatectomy which can usually be accomplished under local anesthesia. However I have found that the ad

ministration of chloroform in no way prejudices the chances of recovery. Open operation should not be done until the pneumonic process has subsided. The objection to thoracotomy lies in the fact that close proximity of the ribs impairs drainage and makes likely rib necrosis from pressure of the tube.

4 Cases which come to the service and are already chronic with pleural adhesions and pocketing of pus cavities will demand the removal of portions of one or two ribs and the separation of the pleura from the chest wall by the hand of the operator. The insertion of some form of drainage which will provide for a negative intrathoracic pressure should be employed. I have found the combination consisting of a stiff rubber tube one half inch in diameter connecting with a collapsible rubber tube just large enough to fit over it snugly draining into a bottle to be most satisfactory. This allows the escape from the chest of pus and air but prevents any air entering through the tube making an automatic pump which permits the gradual distention of the lung and obliteration of the suppurating cavity.

5 The use of the Carrel Dakin fluid will remove the large amounts of lymph which are

so frequently found in these cases. It will diminish the odor, lessen the discharge and oftentimes entirely sterilize the cavity. This will permit closure of the wound as soon as the bacterial count shows the cavity to be surgically clean. I do not think it has any advantage as an antiseptic in these cases over formalin and glycerine. A valuable method of its employment is the insertion of a small rubber tube through a stab wound which will diminish the necessity for dressing and enable one to put in the chest cavity any antiseptic solution which may be desired and to withdraw the same at the same time establishing negative pressure within the chest. (A. E. Mozingo, Captain M. C.)

6 In the very old cases one of the well established very radical operations should be employed but only after the injection of formalin and glycerine into the chest pockets and plugging of the drainage tract as this will in the great majority of cases result in a cure.

7 Beginning just as soon as the patient is able to be out of bed graduated exercises should be employed to encourage the distention of the lungs. This I consider is one of the most valuable portions of the treatment.

## NEGATIVE PRESSURE VERSUS FREE OPEN DRAINAGE IN THORACIC EMPYEMA

By J. CHRISTOPHER ODAY, M.D., F.A.C.S., HONOLULU, HAWAII

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NEGATIVE pressure drainage has for its object certain phases that do not belong to the ordinary methods of drainage and which by some of its advocates are believed to be of considerable advantage in attaining ultimate results. These advantages may thus be enumerated. It re-establishes and maintains the normal relation between the lung and the affected cavity during the time drainage is necessary and when no longer necessary to have left the lung capable of filling the space it filled prior to the onset of the infection it prevents pneu-

mothorax; it prevents the likelihood of introducing secondary infections.

When should thoracic empyema be drained?

What are all the factors to be considered?

How should it be drained?

If we can become impressed with the truth that each case of thoracic empyema has peculiarities of its own it will bring us to realize that the greatest success can only obtain with a plan that may be adjusted either to establishing or delaying drainage according to the exigencies presenting.

With an unresolved pneumonia of the op-

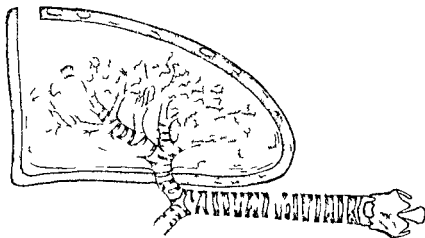


Fig. 1. A method of drainage of the pleural space in a case of pneumothorax. The tube is inserted into the pleural space and connected to a collection chamber.

posite lung drainage especially a drainage that might admit air might be hazardous. This class of case argues strongly in favor of negative pressure drainage, yet the inevitable mishaps likely in opening the chest expose the patient to a risk that had better be avoided by the aspirating of such quantities as are necessary to relieve the pressure until resolution of the opposite lung has taken place.

While this delay in the establishment of adequate drainage may jeopardize the integrity of the lung on the empyemic side, the risk is justified because it is selecting the lesser of two existing evils. In that class of cases where the lung of the opposite side is free from any involvement, all else being equal, nothing is to be gained by delay.

We are now squarely to face with the consideration of the kind of drainage to be employed. Should it be free open stab wound or negative pressure? Seriously then, what are all the factors to be considered before deciding upon the precise way the drainage should be made?

Experiments by me to ascertain the difference in the duration of a pneumothorax produced by nitrogen gas and one by atmospheric air demonstrated that the normal lung may be kept in a state of collapse for months without losing a particle of its elasticity. This is

not true of an infected or inflamed lung for an inflammatory or infectious process with its inevitable exudate infiltrate and subsequent fibrosis if allowed its way, ties the lung from within and so thickens its cortex that re-expansion will never again meet the confines of the original respiratory excursions. Indeed may I add that it is to this very fibrosis that pneumothorax in the obliteration of tuberculous cavities owes its success.

When drainage for any reason has been deferred and the mischief of the delay has been imposed, the resulting thickening of the cortex together with whatever degree of impairment has befallen the normal elasticity of the lung itself must in the very nature of the pathology attained bear a direct relation to the length of time in which the delay occurred. Upon this alone will the size of the dead space between the two pleuræ depend and once this dead space has been established no scheme of negative pressure will be capable of drawing the fibrous or inelastic lung into former relations.

All streptococcic pneumonias do not result in thoracic empyemas. An abscess may form adjacent to a bronchus and even rupture into it, but pyogenesis within the chest comes only as an evidence that the infection has found its way to the periphery. Nor is it necessary that the entire periphery be involved before the pyogenesis begins for a comparatively small

area has been observed in association with the entire cavity filled with pus. It may be well at this juncture to remember that the mere coming in contact with pus does not cause the pleura to thicken or become fibrous. Such a change can occur only within the area where the infection has found its way to the cortex. Often such areas are segregated by a zone of inflammatory adhesions between visceral and parietal pleura localizing the subsequent abscess and often giving rise to the multiple cavities whose presence have infrequently baffled the skill of the best.

#### THE PNEUMATICS OF THE LUNGS

To compute the power of a given pressure of gas steam or air the number of square inches of space and surface must be included. For example if the bore of an engine's cylinder is twenty-four inches in diameter that engine has a greater power than one with a cylinder whose bore is but twelve inches. The difference in the number of square inches determines the power. My alluding to this bit of scientific mechanics is to emphasize the fact that the same principle reckons with the inner and outer surface of the lung. The number of square inches represented by the manifold bronchi bronchioles and alveoli are greatly in excess of those representing the surface. It is this plus the normal elasticity of the lung that makes complete collapse of the lung impossible with a plus pressure pneumothorax. It is also the excursion of exaggerated respirations lengthening the excursion of the collapsed lung to the approximation of the chest wall. This is where we have an advantage in conserving the lung's elasticity during the period it is threatened but to gain this advantage all prejudice toward a free open drainage will have to be set aside.

We know that the pathology resulting from thoracic pyogenesis is destined to distort the lung and whether that lung is left in a state of partial collapse or kept fully inflated by the application of negative pressure drainage the same fate will befall it if exudate and infiltrate organizes while it is immobile the ultimate result being that in the one case the lung can not properly inflate while in the other it will be unable properly to compress.

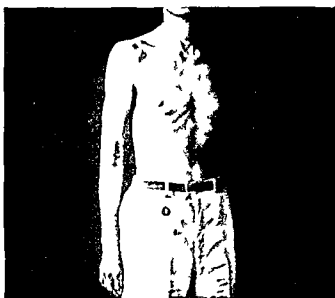


FIG. 2. Case 1.

#### CHRONIC THORACIC EMPYEMA

In dealing with the old cases our course is usually clearly marked. We may be quite right in looking forward to finding a considerable dead space. A chronic fistula is to be no surprise. Lastly we may find it necessary to perform an Estlander or a Schede to close the space and cure the fistula. All this is stereotyped treatment for this all too familiar result of empyema of the chest. It is also good treatment but much of it might be prevented by a more judicious application of drainage in the beginning. But in the recent cases—the cases recognized before aught has impaired the lung's integrity—what then should be our method of attack? It should be one capable of preventing or minimizing the impairment of function inevitable to the process we know to be going on. This is the time when the whole crux of the situation should be squarely met and whatever is decided on as the best can only be the best if resting on a painstaking consideration of every factor involved; moreover it makes for the best there is in surgery by forcing our mind into an attitude whereby it is unwilling to become indifferent to conserving the lung's function so soon as pus is made to appear at some point of opening. The integrity of the lung cannot be safeguarded in the presence of inadequate drainage. The lengthened excursions of exaggerated respirations are only possible with



THE EMPYEMA PROBLEM<sup>1</sup>

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THERL has never been a greater opportunity to study empyema than at the present time. The country is passing through a second epidemic of pneumonia the consequence of which is the accumulation of a very large number of cases of empyema and lung abscess. The first epidemic in the fall of 1917 lasting through the winter was largely confined to the military camps and was mainly due to the streptococcus hemolyticus often associated with the pneumococcus. The second and more virulent epidemic which began in the summer of 1918 swept the country from the Atlantic to the Pacific and did not spend its ravages on the camps alone but attacked as well the civil population. This epidemic appears to be of a different type from that of the previous year being preceded in a large percentage of cases with what is now commonly called Spanish influenza.

Previous to these epidemics empyema was not a common complication of pneumonia; lung abscess was more frequent. We were not accustomed to watch for empyema in each case which recovered from pneumonia. It was somewhat surprising therefore that during the epidemic in September, October and November 1917 at the different camps there appeared among the soldiers a very large number of cases of empyema after bronchopneumonia. It was evident that we had to deal with an unfamiliar type of infection. Not only were the complications more common but the mortality also was very high ranging in various localities from 0 to 60 per cent. At Camp Pike they had from September 1917 to September 1918 185 cases of pneumonia with a total average mortality of 6 per cent. Empyema complicated 9 per cent of these cases of pneumonia. Similar reports came from other cantonments. It was evident that this was an infection of a more virulent variety than we had treated in previous years. The anatomical conditions

of these cases of empyema were likewise different. In the ordinary case of former times as a rule the pleural sac was found filled with pus. In the type which occurred in 1917 many cases had multiple locked off compartments filled with pus sometimes abscesses were found in the spleen, liver and abdominal cavity. It resembled more a pyemia with constant pleural involvement. In the present epidemic of influenza pneumonia in a most violent form with high and rapid mortality asserted itself again and thus we anticipated that empyema might also arise a little later in the recovered cases and this proved to be the fact. I am informed that at the Great Lakes Base Hospital 50 cases of empyema following the last epidemic have already developed from recovered cases of pneumonia.

We must expect the same complications to follow the cases among the civil population and in fact they have already begun to appear.

In a report published in the *Journal of the American Medical Association* November 16 from Camp Sherman (Ohio) of 801 cases of pneumonia resulting from 7,618 cases admitted for so-called influenza 842 died leaving 1,159 which recovered. The writer of the article stated that at the time of publication only one case of empyema had developed in these 1,159 recovered cases. Suspecting that more cases might have developed since the report I inquired and received reply from Major A. Friedlander in which he states that since writing the article there had developed about 150 cases of empyema from the 1,159 which had recovered from the pneumonia.

This indicates that the empyema may develop very slowly and may not be diagnosed until several weeks after the patient had apparently recovered.

We shall learn many new facts from the present epidemic. The reports from the different camps in which they have had the





Fig. 1. L. l. l. p. m. L. l. l. f. l. l.

great advantage of treating many cases of the same type by one method are gradually finding their way into the medical literature and from them we can learn the most. It is somewhat early, however, to make comparative studies since the report from many



I. B. h. l. m. I. f. t. l. d. l. t. d. h. l. p. t. g. m. l. l.

camp are still missing. At the present time we must be satisfied with such meager data of the subject as our present knowledge offers and in attempting this I shall try to answer the following questions:

1. How shall we explain this unusual virulence and high mortality of the pneumonia and empyema?

2. How shall we recognize an empyema early and possibly?

How shall we differentiate an empyema from a lung abscess?

4. What means other than operative may be employed to cure empyema?

How shall we proceed with an operation after we have made a diagnosis?

6. What operation is the most desirable resection of a rib or drainage between the ribs? Local or general anesthetic?

7. What method of drainage shall be introduced?

8. What shall be done to produce disinfection and closure of the pleural cavity in the shortest possible time?

9. What are the causes of nonclosure of drained empyema?

10. What shall be done with chronic suppurative cases with muco-purulent or empyema which have persisted in spite of treatment?

#### Virulence and High Mortality

Thus far no one has ventured to make a positive statement to explain the cause of

the high mortality and the frequency of complications. The causative factor is not definitely known. It has been suggested that the organism causing the epidemic is an ultramicroscopic one not yet demonstrated or the influenza bacillus which prepared the body for the pneumococcus and streptococcus invasion. The susceptibility or rather lack of immunity against this new type of infection is another theory advanced. One fact seems to stand out very plainly, namely that robust adults are more susceptible than the very young children or people above fifty. This is just the reverse of the usual. It is also apparent that persons afflicted with asthma, chronic bronchitis or pulmonary tuberculosis are more often spared than the perfectly healthy. Alcoholism which is

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FIG. 4. Empyema. Cavity half filled with fluid, patient in sitting position. Some paste at the bottom.

considered a predisposing factor to pneumonia cannot be claimed to be so in this epidemic. Young soldiers rarely alcoholics and young women are the most susceptible victims. The almost universal fatality in pregnant women also indicates that we are dealing with a new type of disease.



FIG. 5. Empyema. Cavity half filled with fluid, patient in sitting position. Some paste at the bottom.

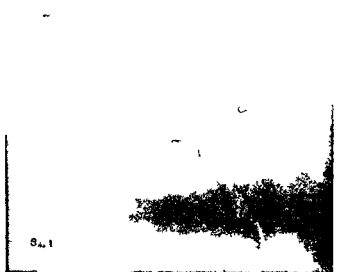


FIG. 6. Empyema. Cavity half filled with fluid, patient in sitting position. Some paste at the bottom.



Fig. 1. Stereoscopic view of the face of a patient with a large, dark, swollen area on the right side of the face (viewer's left).

The mortality rate depends largely upon the violence of the initial attack. Those who are unfortunate in receiving a severe initial blow rarely recover. Cases have been reported which terminated fatally within a hour from apparently perfect health to a corpse within half a day. The patient seems to die from lack of oxygen rather than from the toxic effect of the poison. The lungs are congested to such a degree that the air can not enter the vessels and the patient dies practically from asphyxiation or rather from drowning. The heart and kidney are not sufficiently affected to cause death. When ever a patient has stood the first shock and bridge over the first week of illness he has a fair chance for recovery. An index which is found in the rise of the polymorphous leucocytes in the blood which at the outset is very low, often a low as 4,000 and gradually rises to 10,000 or 15,000.

That the patient does not die from influenza is certain. Only 8 per cent of the fatal cases at Camp Cutler produced cultures of the Pfeiffer bacillus from the secretion of the cut lung and only 3 per cent from the blood while 18 cases produced one or the other type of the pneumococcus and 14 cases the streptococcus. It is therefore evident that further investigation will be necessary to determine the real cause. Our present conclusion is too meager to establish it.

## EARLY RECOGNITION OF EMPYEMA AND DIFFERENTIATION FROM LUNG ABSCESS

It is unnecessary to discuss here the usual physical signs and the part the history bears upon the differential diagnosis. We shall consider only the methods which are corroborative, namely the stereorontgenogram and the probatory puncture.

As soon as percussion and auscultation have convinced us that a certain portion of the chest is normal it is our duty to take a stereorontgenogram of the entire chest. The following conditions must be considered: (1) unresolved lobar pneumonia (2) acute active bronchopneumonia (3) fluid in the pleural cavity or purulent (4) lung abscess (5) pneumothorax (6) acute pulmonary tuberculosis.

The correct interpretation of the stereorontgenogram in the differentiation of the conditions just mentioned is of paramount importance and for this reason I shall present here a roentgenogram of each type to demonstrate differential points.

**Unresolved pneumonia.** A dense shadow corresponding to any of the five lobes with the rest of the lung comparatively normal indicates an unresolved pneumonia. Figure 1 illustrates a typical case. We note that the left upper lobe on the side is quite distinctly outlined in contrast to the rest of the lung tissue. An abscess rarely produces a shadow which would correspond to the shape of a single lobe. It would produce transparent areas representing lung tissue around the abscess and possibly show a dense shadow of the abscess wall which the unresolved pneumonia does not produce.

**Bronchopneumonia** give an entirely different picture. At times both lungs are involved and the picture resembles more that of advanced tuberculosis of the lung. The lung or parts of it are studded with air cysts giving an irregular surface. The air cysts are of an egg shape, some into one another, some between them. When the air cysts are in the pleural cavity the entire surface of the lung is covered by them. When the air cysts are in the lung tissue they are surrounded by a thin wall.



FIG. 8. Tuberculous abscess. *a* formation of abscess wall; *b* abscess wall not so well defined.

posteriorly. The roentgenogram of this condition will present a shadow resembling ground glass, nearly equal in density throughout the entire area occupied by the fluid. This, however, is true only when the patient is on his back while the roentgenogram is being taken, because the fluid gravitates and covers the entire posterior area of the pleural cavity (Fig. 3). In cases in which the quantity of fluid is not large and the roentgenogram is taken in the standing or sitting posture, we will obtain a characteristic picture: the fluid will gravitate into the lowest part of the pleura and produce a dense shadow up to its upper margin—above that there will be a distinct pneumothorax (Fig. 4). Another roentgenogram taken in the lateral position, namely with the patient lying on the affected side, will produce a shadow corresponding to the level of the fluid along the outer part of the chest and a pneumothorax between the margin of the retracted lung and the level of the gravitating fluid. This is clearly illustrated in Figure 5. If the same patient is turned on the unaffected side, the fluid will gravitate toward the middle line and leave a pneumothorax externally (Fig. 6).

The roentgenogram will give us a hint in formation as to the character of the fluid

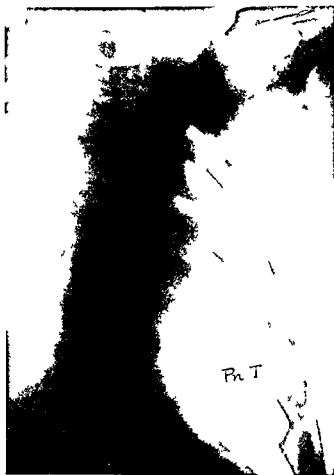


FIG. 9. Pneumothorax. Retracted lung is up and cavity below filled with air.

except that the purulent fluid is likely to give a denser shadow than the serous. It requires probatory puncture to settle this question.

**4. Lung abscess.** The diagnosis of a lung abscess is more difficult. A patient may have had an encapsulated pocket of pus in his lung for months and even years before a diagnosis is made. Its location by physical examination is more difficult because it is usually centrally located and as a rule much smaller than an empyema (Fig. 7). The tuberculous abscess has a distinct wall and is more often multiple and therefore much more easily diagnosed than that resulting from a pneumonia or other causes (Fig. 8). When a patient gives a history of having suddenly spit up a quantity of pus and continues to expectorate purulent material, the presence of a lung abscess must be considered. After an abscess has ruptured into a bronchus its localization becomes more difficult still because the site has collapsed and a proba-



try puncture will in most instances fail to strike the pleural cavity.

**Pneumothorax.** There should be no difficulty in diagnosing a pneumothorax as the physical signs are very characteristic especially the hyperresonance. The roentgenogram however is most convincing. We find here the absence of shadow in a well defined area which means that the lung has retracted and the space is not occupied by fluid but by air which of course produces no shadow whatever. Figure 9 illustrates a typical pneumothorax.

**Effusion in pulmonary tuberculosis.** With effusion will in the roentgenogram resemble very much a fibrinous pneumothorax when areas of infiltration of the lung are in the thorax and clinical findings must be taken into our line of thought. The fluid in the tubercular effusion however gives a characteristic picture namely an apparently transparent lung with no linear markings or response to the friction with many small distinct white half-walled calicel deposits in many places below resembling snowflakes which represent the fine air remaining in the alveoli of the tubercular lung. Figure 10 illustrates such cases.

**Prohibitory puncture.** The prohibitory puncture should never precede the roentgenogram because the latter will assist in choosing the place for the introduction of the needle. The indiscriminate use of the prohibitory puncture is a dangerous procedure. One should strike the pleura if it is there the very first time. It should not be done more than

three punctures. If after the third puncture the pleura cannot be found the case should be studied further by other means.

The danger of introducing the needle consists in puncturing a healthy lung and carrying the infective material into it and causing a secondary abscess. One might push the needle beyond the confines of a small abscess and thus get no result. In withdrawing the needle one should use some suction at three or four different depths. The pleura at times is so thick that it will not flow through a very small calibered needle thus a suction syringe should always be attached to the needle.

The character of the pus is of great diagnostic value. A mere preparation is well a culture should be made from the time at once in order that the fluid is of a purulent character it should be placed in a test tube to see how much sedimentation will occur within 4 hours.

#### NON-OPERATIVE TREATMENT

The introduction of antiseptic into the fluid within the pleural cavity has been advocated for a number of years. Treatment with 1 per cent formalin and glycine was introduced by Murphy and has been used extensively by Kneuchner and others as a tincture. It is supposed to sterilize the fluid within the cavity and gradually absorbed thus making its withdrawal unnecessary. It seems to produce either closure following drainage or otherwise cured without opening and it has made unnecessary extensive thoracic surgery. It cannot be used in children or in cases with tuberculous effusion but gives a better result in empyema following pneumonia or ordinary pleurisy after the pleuritic effusion has become purulent. The chief objection to the formalin is that it produces a great deal of pain. The method is not extensively employed the reason for this is not quite apparent.

Repeated puncture and withdrawal of small quantities of the fluid at regular intervals has been found effective by a number of surgeons at the military camps. The gradual withdrawal of the fluid by means of a syringe has the advantage of being comparatively

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Fig. 11

Fig. 12

Fig. 13

Fig. 11 First step Large rubber tube removed. Tube attached to catheter ready for insertion.

Fig. 12 Second step Tube soaked in oiler.

Fig. 13 Tube in place to remain until discharge of pus.

harmless but it carries an uncertainty of a final cure. We cannot hope to withdraw every drop of the pus from the pleural sac and since we are bound to leave a certain quantity the question must arise in our mind what becomes of the residue. Will it be absorbed? If nature is able to absorb a residue of pus why cannot he absorb the entire quantity. The advocates of the repeated puncture method must clear up this point by citing a sufficient number of cases with control of roentgenogram comparative studies.

Vaccine therapy is too large a subject for this paper but it must be taken into consideration. Personally I have had no experience whatsoever there are a number of articles some speaking favorably others unfavorably about this method of treatment.

#### WHEN TO OPERATE

During the present epidemic we have noted that in the very acute cases of pneumonia a gross fluid very septic in character is frequently thrown out into the pleura and compresses the affected lung. This clear fluid will gradually assume a purulent character. If we withdraw about 10 cubic centimeters of this fluid every 4 hours and pour it into a test tube we will note that the

sediment of the samples will vary. The amount of the grayish purulent material settling at the bottom of the tube will be greater each day so that the fluid drawn on the tenth day might contain as much as 50 to 40 per cent of sediment and 60 to 70 per cent of clear serous fluid. It is therefore very difficult to say at what particular stage of purulization we shall regard the case as one of empyema. Experience has shown that it is not safe to operate in the acute stages when the fluid is still serous. In the report of the Empyema Commission in charge of Major Dunham at Camp Lee the following statement is made:

Our observation forces us to the conclusion not only that a late operation has decreased the risk of death but also that it has in general been followed by a less troublesome convalescence. Almost without exception the cases in which at the present time there are still large cavities are one in which operations were performed early. Whether or not the fact that the operation was performed late or in the post-pneumonic stage of the disease has borne a direct relation to the more rapid post-operative obliteration of the cavity cannot be definitely answered. The observation may be only a coincidence but yet it has been so striking as to suggest that a definite causal relation has existed.

Whether the deduction of the Empyema Commission namely that the mortality is



F 4 R t g h t f r t t  
n t l m i l m t h p t t t h  
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t h p t l l d t h l m u t h

F 5 L l d n t t h m l p o c k t i n  
t h p e

due to the sudden pneumothorax a correct or not the fact remains that very early operation is dangerous and should not be undertaken. The theory of the pneumothorax alone does not appeal to me as being the great factor in producing the death rate because the lung had constantly been in a state of compression by the fluid previous to operation. The lung was immobilized by the fluid and the sudden withdrawal of the fluid released this immobilization and thereby aggravated the condition because at this time the lung is still in an acute state of inflammation. Another cause which might be responsible for the mortality is the operation itself. The resection of a rib although not very extensive opens a sufficiently large wound surface for secondary infection and absorption of microorganisms which are contained in the apparently harmless fluid (but very septic in fact usually the streptococcus). The patient has not as yet acquired sufficient immunity against this particular micro

organism. This is not entirely theoretical. It has been proven in a number of cases that where the blood cultures were free from microorganisms just before operation positive blood cultures could be obtained 4 hours later. I cite from the article by the Lymphoma Commission Camp Lee Virginia.

The great danger is producing a blood stream infection definitely an absorption of the toxin from the rib. I feel old. The fact is a real danger to the patient that the infection is rapidly progressing. It is a sterile blood poisoning which is from the blood taken 4 hours after operation. The duration of the infection is trept co.

It is evident that after the fluid has become purulent it has lost a great deal of its virulence at least to the same individual in whom it has been formed. In other words it has become cold. We know from experience that the longer pus has been retained within a certain location in the body the less virulent or toxic it is. We may therefore con-

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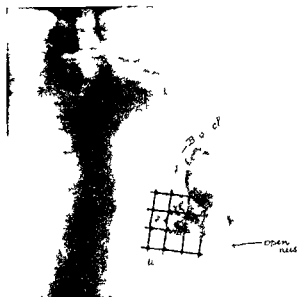


Fig. 6. Roentgenogram showing communication of abscess in the lung with the bronchus.

clude that it is much safer to defer the operation until the fluid has become distinctly purulent although it is permissible or even advisable to withdraw small quantities with a small cannula to relieve distressing symptoms.

#### CHOICE OF OPERATION AND ANESTHESIA DRAINAGE

The simplest operation must appeal to us as the most desirable. The method advocated by Major Hugh McKenna of Chicago appears to be the simplest. It consists in introducing a catheter size No. 14F by means of a trocar or cannula just large enough to thread the catheter into the pleural cavity. As soon as the pus escapes through the catheter the cannula is withdrawn about 100 cubic centimeters of the pus is then withdrawn by means of an aspiration glass syringe. If the pus is too thick for aspiration a small amount of neutral solution of chlorinated soda (Dakin's solution) is allowed to run in which dilutes the pus and renders it easier to withdraw. My reasons for endorsing this method are the following: First the operation is so simple that the patient takes no more risk than in the ordinary probatory puncture. Second the wound produced by this operation is so small and the catheter is

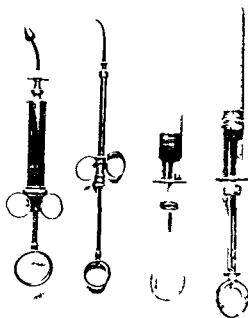


Fig. 7. The four types of syringes generally employed: *a*, blunt tip glass syringe employed in most cases of sinus; *b*, glass syringe with long nozzle suitable for empyema cases; *c*, dental metal syringe used in small sinuses about the teeth and for pyorrhea; *d*, metal syringe with olive shaped tip used in rectal fistula and small sinuses elsewhere.

hugged by the tissues so closely that an infection of the wound is not likely to take place. Third the fluid can be withdrawn gradually—about 100 cubic centimeters every 4 hours without allowing any air to enter the cavity thus preventing a pneumothorax. For this reason a clamp should be placed on the catheter during intervals of evacuation. The lung is likely to re-expand gradually as the amount of fluid within the pleura diminishes. However even this operation should not be performed in the very acute stages while the fluid is still serous because at that stage the lung itself is in an acute state of pneumonia and should therefore remain undisturbed. By permitting a lung which is acutely inflamed to expand we open widely the door for death. Whether the drainage of pus in the cases thus treated will persist or whether pus will reaccumulate after closure the future only will tell. So far the reports have been very favorable but it is rather early to pass judgment.

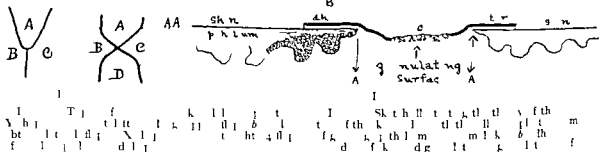
*The counter drainage method.* At the North Chicago Hospital we have during the past





For several years employed a method of draining empyema which proved most satisfactory. It was introduced by Dr. George Dohrmann and carried out in one case with only one death. (A child died suddenly on the fourth day after operation cause unknown.) The remaining cases closed without any recurrence. The method is the following: A section of about one inch of the eighth or ninth rib is resected posteriorly under local anesthetic. The pleura is exposed and incised about one-half to one inch. Before any pus can escape the index finger is pushed through into the pus cavity thus almost entirely blocking the pulmonary artery space. A curved artery clip is then inserted along the index finger and directed anteriorly and downward to the lower tip into the empyema

cavity. Holding the tip of the forceps against the inner chest wall between the rib will rupture the skin and indicate the place for the counter incision which is quite easily made under local anesthetic by the assistant. A small rubber catheter No. 1 or 14 is then grasped with the forceps and pulled through. The catheter has three or four small openings in the center. A large size rubber tube is then slipped over the catheter and introduced into the large opening of the resected rib. This rubber tube is sewed to the skin so as to make it airtight. A glass connecting tube is then fitted into the large rubber tube which drains the pus into a flask either through suction or natural gravity. The patient is allowed to lie in a recumbent position in bed immediately after the operation.



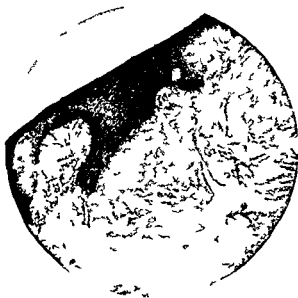


Fig. 13. Microscopic section of the growth of kink tissue after formation.



Fig. 24. Roentgenogram of the chest showing the cavity partially filled with pus. Patient in sitting posture.

Four days later the large tube should be removed, the catheter remains in place and drains from both side for two weeks. By this time the discharge has usually greatly diminished and we are ready for a new step in the after treatment.

A tape about one quarter of an inch in width is attached to one end of the catheter by means of a silk thread and the catheter is withdrawn thus pulling the tape into its place. This tape then serves as a drain for the cavity similar to that of a seton. The tape is soaked in a 10 per cent argyrol solution before its introduction. This tape is left in the cavity until the discharge of pus ceases and this has been the result in practically every case in which this method has been employed.

The three steps of the after treatment are illustrated in Figures 11, 12 and 13.

I would place this operation second to that recommended by Major McKenna because it is not quite as simple as his. I describe it here because the end results of the counter drainage operation have been satisfactory and should this simple drainage by means of a catheter not accomplish the final result the counter drainage operation would then be the one most likely to be adopted.

In regard to simple drainage such as we

have been accustomed to do I wish to offer a few suggestions first that the most advantageous location for introducing drainage is posterior and as low as possible preferably the ninth rib providing it is certain that the cavity extends that low. If the angle of the diaphragm and chest wall is obliterated by adhesions the insertion of the tube may have to be higher and the eighth or seventh rib may be chosen if necessary but by all means it should be done posteriorly. I recommend posterior drainage for two reasons. It is the most desirable point for draining in the lying as well as the sitting posture. Most of the chronic persistent sinuses after resection that have come under my observation have been on the interior chest wall along the fourth or fifth rib or in the axillary line sometimes as high as the arm pit. Very few cases persist in draining when the opening has been made very low posteriorly.

In introducing a large rubber tube care should be taken that it does not protrude too far into the pleural cavity. If it can be fixed so that it is just level with the inner chest wall it will prevent the friction of the lung against the edge of the rubber tube. The suction method for re expansion of the lung is to be highly recommended but it must be done systematically and without any undue force.





Fig. 3 Microscopic section of new growth of kinetoplast after formation



Fig. 4 Radiogram of chest showing size of cavity partly filled with pus. Patient in sitting posture

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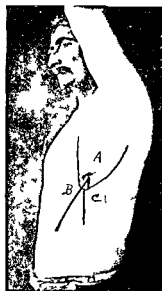


Fig 5



Fig 6



Fig 7

Fig 5 C dt l f op t with k t h f  
p p d y h p e c s (C e )  
I g b Sk fl p m l d f t t l t t h d sed  
d p ty p d Th fl at g p s lea ly se

Fig 7 Th ty h be be f lly p s d t the  
m l d f t h be r m d Th k a n d p  
r dy f t

Local anæsthesia should be employed almost exclusively. I shall not waste any time in describing the technique of resection of the rib for empyema, but I cannot refrain from mentioning one point which has been very helpful to me, namely, instead of making a straight incision over the rib which is to be resected, I make a curved incision and thus the field is opened up and the operation performed much more quickly.

#### RAPID CLOSURE IN AFTER TREATMENT

What shall be done to produce disinfection and closure of the pleural cavity in the shortest possible time?

The flushing of empyema cavities with disinfecting fluid was extensively used until about fifteen years ago. Weak solutions of permanganate or iodine or boric acid were the favorite solutions employed. The practice was then discontinued until during recent years when Doctor Carrel renewed the interest of the profession in this treatment by showing his good results from flushing infected wounds and pus cavities with what is now known as the Carrel-Dakin solution. The pros and cons for this method are very numerous. The method is on trial. Judging from the

reports in the literature the results will justify its employment in the future. Personally I have had too little experience with it to justify any definite conclusions of my own. As to its technique I refer the reader to the description by the Empyema Commission<sup>1</sup> in its report in the *Journal of the American Medical Association*. One of the most important advantages of the use of Dakin's solution which I have observed in the cases in which I employed it was its solvent action on fibrinous adhesions of the lung. It was noted that many cases of empyema which had recovered returned blocked off abscess cavities due to fibrinous adhesions of the lung. The employment of the Carrel-Dakin solution dissolved these adhesions and the pus cavity was thus opened emptying its pus into the main cavity from which it drained freely. This no doubt saved a great many from secondary operations. I desire to illustrate a typical case of this nature.

A man of thirty years, healthy, became suddenly ill with influenza. He had a severe pneumonia followed by a pleural effusion. The temperature was 101°F. at the end of the first week.

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chest was filled with a fluid. After probatory puncture (pus with numerous streptococci) an inch of the ninth rib was resected posteriorly under local anesthesia a counter opening was made at the same time anteriorly and a large perforated catheter was introduced passing through both openings. This drainage was kept up for two weeks. The patient improved rapidly the pus gradually becoming thicker and more purulent. The catheter was then removed and the cavity injected with 300 grams of bismuth paste a mixture containing 10 per cent bismuth subnitrate and 90 per cent vaseline. A set of stereoroentgenograms was taken with the patient in a horizontal position. From a single roentgenogram we would judge that the entire left chest cavity is filled with the mixture. The stereoscopic set of roentgenograms however definitely proves that this is not the case. We note that the mixture simply gravitated to the posterior surface of the pleural cavity producing a shadow covering the greater part of the left chest. (Plate I.) The mixture does not fill the entire depth of the pleural space the heart and the retracted lung are in front of it. This fact can only be visualized by the stereo copic roentgenogram the single plate is misleading. The interesting finding of another abscess and proof of this is given in another roentgenogram patient in the sitting posture (Fig. 14). The bismuth mixture has now gravitated downward and left the upper two thirds of the cavity empty and thus transparent. The mixture accumulated at the bottom giving a square shaped shadow. We note however that a portion of the mixture has been retained in a pocket in the upper anterior portion of the chest. It evidently ran anterior to the lung at the apex. The mixture here gives a distinct outline of a locked off abscess with a distinct waterline mark on its upper margin *B*. Such roentgenograms as this are essential for a correct diagnosis and greatly facilitate the treatment.

It will depend upon the final results whether the irrigating method will become a permanent armamentarium in the treatment of these cases. We must take into account that heretofore we have been accustomed to promise our patients a closure of an empyema in at least 19 out of 20 cases and this was done when we treated them by simple drainage without irrigation. If the irrigating methods will produce better results than that they will retain their place if the percentage of discharging sinuses will be larger than before the profession will be tempted to return to simple drainage without irrigation. We must not be misled by some adverse reports on the Carrel Dakin solution for it is quite possible that some did not obtain the desired results because they did not follow the tech-



Fig. 8 Site and location of cavity outlined by injection of bismuth paste

nique laid down by Carrel in its finer details. If one desires to employ another man's method he must follow it to the letter and not try to make modifications of his own. I believe this has been the case in the use of the bismuth paste method of treating sinuses. It is of course possible that the type of cases with which we are dealing now will not yield the same good results with simple drainage as the cases did in former years but since there has been no trial made of simple drainage on as large a scale as that of the flushing method with Carrel Dakin solution the question is open to investigation.

The cases which do not yield to the flushing method should be treated with the injections of bismuth paste. It is unnecessary here to go into this method of treatment in detail since I have from time to time published the technique as well as the results obtained but since empyema is now so prevalent and the use of the paste will probably be much greater in these cases than ever before I believe it will be of advantage to give some of the important points in the correct technique which is so essential for the attainment of good results. The injection of bismuth paste serves two purposes first diagnostic second therapeutic.

*Diagnostic points* The various shapes of the empyema cavities can be better visualized by filling them with bismuth paste and then taking a set of stereoroentgenograms.

Such roentgenogram will give a clear picture of the size location and depth of these cavities. Studying them we can define with accuracy the boundaries and anatomical relations of the cavity and thus plan our operation and treatment accordingly. In some case the pleural surface adheres and nearly obliterate the entire pleural space and leave a long sinus leading into a pocket not larger than a crab apple (Fig. 15). The injection of bi-muth into the sinus will likewise give a clear picture of the existing conditions. In some instance roentgenograms will show a straight channel from the skin opening in the chest wall leading directly into a bronchus which indicates that the pre-existing cavity has bridged down to a straight sinus but did not close on account of the communication with the bronchus.

The introduction of the catheter into an empyema for the purpose of eliminating the extent or size of the cavity is not a reliable one. I prove this by exhibiting Plate II.

In this particular experiment I have introduced two catheters at an angle of each other into the opening in order to ascertain whether they will be parallel after introduction. A view of the stereoscopic roentgenogram clearly demonstrates the fallacy of trying to ascertain the boundaries. One of the catheters run up into the apex and make a mill curve and the other curl upon itself and point downward after it has reached halfway into the empyemic cavity.

Multiple abscesses in the lung may be shown by injecting them with bi-muth paste even if they communicate with the bronchi because they very often communicate and septa only separate the cavities (Fig. 16). I wish to illustrate a case in which two abscesses one above the other distinctly outlined which do not communicate appear in one lung (Plate III).

To determine the presence of a communication between the abscess cavity and the bronchus the injection of bi-muth paste is most dependable because the patient will cough up the mixture. As soon as the existing cavity has been completely filled the overflow will penetrate into the bronchus and the patient will get a coughing spell during which

he will eject some of the paste. A word of caution is here necessary namely that the paste should in such case be injected very slowly and the patient asked not to inhale during this injection for he may aspirate some of the mixture into the other side of the lung while it is passing up through the trachea. It may also produce a choking spell if a large amount of the paste is forced into the trachea. For this reason the mixture must be liquid. We realize that as the trachea is several inches long and its lumen not very wide it is very easy to close up the lumen by a column of thick paste and the patient would be unable to inspire any air what ever. When there is an accumulation of pus in the abscess cavity the paste mixture will displace the pus drive it into the bronchus and the patient will cough up a quantity of pus before any paste will appear in the expectoration.

It is of course absolutely necessary that when a foreign body is the cause of the abscess that it be localized before any treatment is attempted. Here the stereoroentgenogram is almost indispensable for the determination of the exact location of the foreign body. An extensive study of the subject will be found in my publication entitled "The Localization of Foreign Bodies by means of Stereoroentgenograms" published in the *Stereo Clinic* in 1911. Without the help of stereoroentgenograms I should have been very much handicapped. They have been a most useful adjunct in my armamentarium for the treatment of chronic empyema.

After a satisfactory anatomical diagnosis has been made by means of the roentgenograms the next step is to ascertain the character and quantity of the discharge. In some cases it is a green foul smelling pus in some a serous semipurulent fluid resembling dirty dishwater in others a creamy or chocolate colored thick pus. The color of the pus depends very often upon the substances which have been used in the treatment. Irrigations of permanganate or silver nitrate especially change the character and color of the secretion. We invariably take a culture and smear of the pus and whenever it seems necessary we inject one or two





Such roentgenogram will give a clear picture of the size, location and depth of these cavities. Studying them we can define with accuracy the boundaries and anatomical relation of the cavity and thus plan our operation and treatment accordingly. In some cases the pleural surfaces adhere and nearly obliterate the entire pleural space and leave a long sinus leading into a pocket not larger than a crib apple (Fig. 15). The injection of bi-muth into the sinus will likewise give a clear picture of the existing condition. In some instances roentgenogram will show a straight channel from the skin opening in the chest wall leading directly into a bronchus which indicates that the communicating cavity has traveled down a straight sinus but did not close on account of the communication with the bronchus.

The introduction of the catheter into the empyema for the purpose of determining the extent or size of the cavity is not a reliable one. I prove this by exhibiting Plate II.

In this particular experiment I have introduced two catheters in the side of each thorax into the opening in order to ascertain whether they will lie parallel after introduction. A view of the stereoscopic roentgenogram clearly demonstrates the fallacy of trying to ascertain the boundaries. One of the catheters run up into the apex and make a small curve and the other curl upon it distal point downward after it has reached halfway into the empyema cavity.

Multiple abscesses in the lungs may be given by injecting them with bi-muth paste even if they communicate with the bronchus because they very often communicate and possibly separate the cavities (Fig. 16). I will illustrate a case in which two abscesses one above the other distinctly outlined which did not communicate appeared in the lungs (Plate III).

To determine the presence of a communication between the abscess cavity and the bronchus the injection of bi-muth paste is most dependable because the patient will cough up the mixture. As soon as the existing cavity has been completely filled the overflow will penetrate into the bronchus and the patient will get a coughing spell during which

he will expectorate some of the paste. A word of caution is here necessary namely that the paste should in such case be injected very slowly and the patient asked not to inhale during this injection for he may aspirate some of the mixture into the other side of the lung while it is passing up through the trachea. It may also produce a choking spell if a large amount of the paste is forced into the trachea. For this reason the mixture must be liquid. We realize that the trachea is over an inch long and its lumen not very wide it is very easy to clog up the lumen by the column of the bi-muth paste and the patient would be unable to inspire any air what ever. When there is an accumulation of pus in the abscess cavity the paste mixture will displace the pus drive it into the bronchus and the patient will cough up a quantity of pus before any paste will appear in the expectoration.

It is of course absolutely necessary that when introducing bi-muth paste into the abscess that it be localized but no remedy treatment is attempted. Here the treatment is no remedy at all in hopes of the determination of the exact location of the foreign body. An extensive study of this subject will be found in my publication entitled "The Localization of Foreign Bodies by means of Stereoscopic Roentgenogram" published in the *Stereoscopic Review* in 1914. Without the help of stereoscopic roentgenogram I should have been very much handicapped. These have been a most useful adjunct in my armamentarium for the treatment of chronic empyema.

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The introduction of the catheter into an empyema for the purpose of estimating the extent or size of the cavity is not a reliable one. I prove this by exhibiting Plate II.

In this particular experiment I have introduced two catheters along side of each other into the opening in order to ascertain whether they will be parallel after introduction. A view of the thoracic roentgenogram clearly demonstrates the fallacy of trying to ascertain the boundaries. One of the catheters run up into the apex and make a small curve and the other curl upon itself in a point downward after it has reached halfway into the empyema cavity.

Multiple abscesses in the lungs may be shown by injecting them with bismuth paste even if they communicate with the bronchus because they very often communicate and eventually separate the cavities (Fig. 16). I illustrate with this a case in which two abscesses one above the other distinctly outlined which do not communicate appear in the lungs (Plate III).

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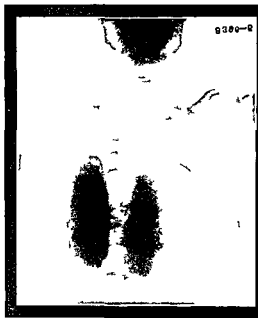




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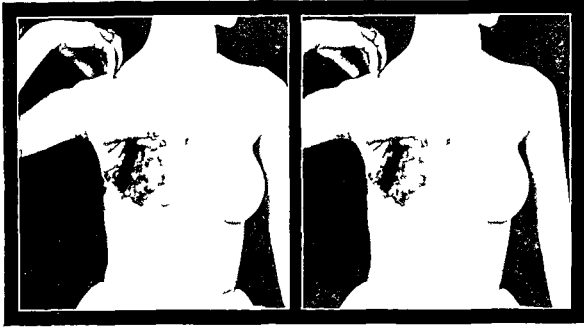


Plate IV Condition two weeks after skin sliding operation showing deep cavity still granulating



Plate V Regeneration of skin complete Patient able to use the arm

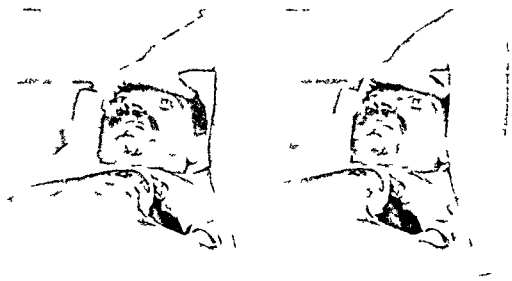


Plate VI Condition of cavity of second case five weeks after operation. Illustrating adhesive plaster method of regeneration of skin. Note regeneration of skin on all lips



guinea pigs with a 10 per cent solution of this pus. In practically all the cases we find the staphylococcus in addition to this we find the streptococcus in about 50 per cent of the cases. The tubercle bacillus is rarely found in the secretion even in the cases in which the empyema is positively of tuberculosis origin.

We have made one remarkable observation in this connection namely that in the cases known to be of tuberculous origin in which tubercle bacilli could not be found in the secretions the bacilli would appear after injecting the cavity with bismuth paste and were then present within 24 hours in very large numbers in each smear preparation often as many as a hundred in each field. This surprising finding was verified in a number of cases during the past ten years. These tubercle bacilli however differ somewhat in their appearance and staining qualities from those which we usually find in tuberculous sputum they are beaded resembling somewhat a miniature chain of streptococci staining also much darker than the tubercle bacillus usually does. The number of these bacilli gradually diminish and within 3 or 4 weeks the secretion will be free from the same.

My explanation for the appearance of these bacilli after the injection is the following. The tubercle bacilli live within the walls of the sinuses or the abscess wall and not in the secretions. It requires a local leucocytosis to provoke their exit. The injection of a substance like bismuth subnitrate produces a leucocytosis within the walls and by this means the bacilli are carried out in the discharge. I am of the opinion that the modus operandi consists in a battle between the tubercle bacilli and the leucocytes resulting in the death of the bacilli and their expulsion into the secretions. Possibly the same may be true in the case of other micro organisms and this would in a degree account for the surprisingly rapid sterilization of large infected cavities. I have as yet no confirmatory laboratory evidence of the above theory but the theory seems plausible and is supported by clinical evidence.

*Therapeutic points Bismuth paste treatment.* This is the most conservative and at

the same time the most effective treatment of these chronic discharging sinuses of the chest. This opinion is not based alone on my own experience in over 150 cases but from reports and observations of many large hospitals in this country and abroad as well as from my observations at the Great Lakes Base Hospital. By this time the bismuth method is well known and the results from its employment and its dangers are well defined. After ten years of trial it has retained its place and is employed more extensively now than ever. The reports in the literature indicate that at least four out of five cases of the very old neglected suppurative empyema or lung abscesses may be cured by this simple procedure. Ochsner of Chicago reported to the American Surgical Association on June 4, 1909 14 cases of empyema all of which had been operated upon (two by Estlander's operation) with sinuses in all cases persisting nevertheless. He applied the bismuth paste in each of these cases with the result that 11 cases healed completely and two were still under treatment at the time and very much improved. Others have reported equally good results. In my own series of 150 cases approximately 80 per cent were cured by the bismuth injection treatment alone.

*Technique of bismuth paste treatment.* Before the treatment is instituted a set of stereoroentgenograms of the entire chest (plate size 14x17) should be taken in order to visualize if possible the retracted lung adhesions thickened pleura or discover foreign bodies if such be present. The cavity is then injected with a 10 per cent bismuth vaseline paste.<sup>1</sup>

When the cavity or sinus is completely filled with this mixture another set of stereoroentgenograms is taken. This set will illustrate the exact size of the cavity and its relation to the ribs and other structures in the chest. The second set of stereoroentgenograms shows that the cavity is entirely filled with bismuth and usually marks the inner boundary of the cavity formed by thickened pleura. The sizes and shapes of these cavities vary greatly no two are alike.

<sup>1</sup> I f m y r s l m p l y j m re ta ing s pe ent b m th  
b tra b t f d that th bo m vt re prod quality good  
esul d is t ck ly t ca se b m th bsorpt



The paste is not supposed to be retained in the cavity and allowed to remain there for absorption. Many have the idea that the paste serves as a filling substance to obliterate dead space. This is an error which might lead to serious complications especially bismuth intoxication. The paste is to remain about two to five days and if it does not spontaneously escape it should be drawn out by means of a catheter attached to a suction syringe.

In order that the mixture may be correctly prepared I here include a formula and rules by which it has been prepared at the North Chicago Hospital for the past twelve years.

App t

|             |           |                            |
|-------------|-----------|----------------------------|
| B m th      | bnt t     | C P                        |
| Y ll        | l e       | (b e t g a d )             |
| 3 W h t a   |           |                            |
| 4 L g po    | la m      | ing bo l                   |
| 5 "po       |           |                            |
| 6 L         | m l j     | th c f t ring p t          |
| 7 S         | l m l j   | r w th co f l q e f ying   |
| p t t t m f |           |                            |
| 8 Adh       | t p f t l | r f th jars t k p          |
| mo t        | d d t f m | t a m n t u n g th p s t e |
| 9 W t b     | th f h    | t u n g p a t              |
| t h q       | St n l    | rubb gl t w l s t f sept c |

Bismuth p s t i t e n per cent mixture one p r t f b i m u t h a b n u t a t e t o n i n e p a r t s o f a s c l i n w i t h a s m a l l m u t f w h i t e w a r ( 2 o u n c e s t o 2 0 p o u n d s o f p a s t e ) . T h e m i x i n g b o y l j a r s a n d s p o o n a e t r i z e ! t h e v a s e l i n e i s s t e r i l e d f o r o m i n u t e s i n t h e r n a l c o n t a i n e r i n t h e a u t o c l a v e . T h e b i s m u t h a b n u t a t e i s s t e r i l e w h e n i t c o m e s f r o m t h e m a n u f a c t u r e a n d s o d o e s n o t h a v e t o b e r e s t r i e d . T h m i x i n g b o y l a n d j a r s m u s t b e a b s l u t l y d y a t h e s l i g h t e s t a m o u n t o f w a t e r p r o d u c e s a c u d l i n g o f t h e p a s t e .

The bismuth subnitrate is p u r e d i n t o t h e m i x i n g b o y l a n d a l l l u m p s s m o t h e d u t w t h t h e s p o o n . A s u f f i c e t a m o u t f v a s e l i n e h c h i s s t i l l i n a l i q u e f i e d c o n d i t i o n f m t h e s t e r i l i n g s s l o w l y p o u r e d n t o t h e b i s m u t h t m a k e a s t i f f p a s t e . T h i s m i x t u e i t h e n s t i r e d f o r a n h o u u n t i l i t a s m o o t h b r i g h t y e l l o w h o m o g e n e o u s p a s t e . T h i s s t h e m o s t i m p o r t a n t s t e p i n t h e p r o c e s s a n d i f n o t c a r r i e d o u t c r e f u l l y t h e p a s t e w i l l n o t b e h o m o g e n e o u s .

T o t h e b a l n c e o f t h e n i n e p a r t s o f t h e l i q u e f i e d v a s e l i n e a s m a l l a m o u n t o f w h i t e w a r w h i c h h a s b e e n h e t e d t l i q u e f a c t o n s a d d e d ( 2 o u n c e s t o o p o u n d s ) a n d t h e n t h i s m i x t u e i s g r a d u a l l y a d d e d t o t h t h i c k p a s t e s t i r r i n g i t c o n s t a n t l y . T h e r e s u l t i n g p r o d u c t s h o u l d b e a l i g h t y e l l o w s m o o t h h o m o g e n e o u s p a s t e w h i c h o n c o o l i n g b e c o m e s c o n g e l e d w t h o u t t h e p e c i p i t a t i o n o f t h e b i s m u t h .

A t t h e t i m e o f u s e s m a l l a m o u n t s o f t h i s p a s t e ( 8 t o 1 0 o u n c e s ) a r e t r a n s f e r r e d t o s m a l l j a r s i n w h i c h t h e p a s t e i s l i q u e f i e d a n d f r o m w h i c h i t i s u e d . T h e s e j a r s s h o u l d n o t b e m o r e t h a n h a l f f u l l a n d g r e a t c a r e s h o u l d b e t a k e n n o t t o g e t a n y w a t e r i n t o t h e p a s t e w h i l e h e a t i n g i t .

T h e s y r i n g e s t h a t a r e u s e d a r e b o t h g l a s s a n d m e t a l ( f i g 1 7 ) t h e b a r r e l h o l d i n g f r o m o n e h a l f t o t w o o u n c e s o f p a s t e . T h e s e s y r i n g e s h a v e d i f f e r e n t s h a p e d p o i n t s a n d n o z z l e s a c c o r d i n g t o t h e d e m a n d o f t h e c a s e . T h e s y r i n g e s a r e s t e r i l i z e d a n d k e p t i n s t e r i l e e l u n t i l t h e y a r e t o b e u s e d w h e n t h e y a r e f i l l e d w i t h l i q u e f i e d p a s t e .

T h e t r e a t m e n t s h o u l d b e c o n t r o l l e d b y r e p e a t e d b a c t e r i o l o g i c a l e x a m i n a t i o n o f t h e s e c r e t i o n s . N o a t t e m p t s h o u l d b e m a d e t o i r r i g a t e t h e c a v i t y b e f o r e t h e i n j e c t i o n . T h e p a t i e n t s h o u l d b e p l a c e d i n s u c h a r e c u m b e n t p o s i t i o n t h a t t h e s i n u s o p e n i n g i s o n t h e h i g h e s t l e v e l . T h i s w i l l a l l o w t h e a i r t o e s c a p e w h i l e t h e b i s m u t h i s b e i n g i n j e c t e d . A t w o o u n c e s y r i n g e i s f i l l e d w i t h t h e l i q u e f i e d p a s t e t h e l o n g n o z z l e o f t h i s s y r i n g e a s s h o w n i n F i g u r e 1 8 i s i n t r o d u c e d i n t o t h e s i n u s a n d t h e p a s t e s l o w l y i n j e c t e d i n t o t h e c a v i t y . U p o n w i t h d r a w a l o f t h e s y r i n g e s o m e b u b b l e s o f a i r w i l l e s c a p e . A s e c o n d s y r i n g e f u l l i s i n t r o d u c e d i n t h e s a m e m a n n e r a n d a s a r u l e t h i s w i l l f i l l m o s t o f t h e s m a l l e r c a v i t i e s w h i c h i s i n d i c a t e d b y t h e o v e r f l o w o f t h e m i x t u r e f r o m t h e s i n u s . A t t i m e s h o w e v e r i t r e q u i r e s 1 0 t o 1 2 o u n c e s o r e v e n m o r e t o f i l l a n e m p y e m a . N o a t t e m p t i s m a d e t o p l u g t h e o p e n i n g f o r t h e r e t e n t i o n o f t h e p a s t e . A s i m p l e s t e r i l e d r e s s i n g w i t h a s n u g l y f i t t i n g b a n d a g e i s a p p l i e d . A g r e a t e r p a r t o f t h e p a s t e w i l l e s c a p e w i t h i n 4 h o u r s .

T h e f i r s t i n j e c t i o n d o e s n o t a l w a y s p r o d u c e p e r m a n e n t h e a l i n g . I t r e q u i r e s a t t i m e s r e p e a t e d i n j e c t i o n s d u r i n g s e v e r a l m o n t h s b u t w h e n e v e r t h e d i s c h a r g e c h a n g e s f r o m p u s t o a s e r o u s c h a r a c t e r t h e i n j e c t i o n s h o u l d b e s t o p p e d b e c a u s e h e a l i n g w i l l u s u a l l y f o l l o w . O n l y w h e n t h e d i s c h a r g e c o n t i n u e s t o b e p u r u l e n t s h o u l d w e c o n s i d e r a m o r e r a d i c a l p r o c e d u r e .

*Causes of non closure of drained cases*  
I h a v e t r i e d t o a s c e r t a i n w h y s o m e c a s e s r e s p o n d t o t h e b i s m u t h t r e a t m e n t a n d w h y o t h e r s d o n o t a n d I h a v e c o m e t o t h e c o n c l u s i o n t h a t w h e n e v e r t h e c a v i t y h o l d s m o r e t h a n 2 0 0 g r a m s i t w i l l b e l e s s l i k e l y t o h e a l b y b i s m u t h i n j e c t i o n s . C a s e s w h i c h c o m

municate with the bronchi are also more resistant than simple empyema. Some cases will heal shortly after the injection and remain closed for a year or two and the patient be in good health often gaining as much as 30 pounds and then the sinus will reopen. The injections are then to be repeated. Closure usually follows for another year or two and the patient may have another relapse after a long period. The patient often prefers to keep up treatment in this way not being much inconvenienced and perfectly well in the intervals.

In studying a large series of cases which failed to close the following causes have been found to be the factors

- 1 In many cases the retracted and infiltrated lung tissue cannot expand sufficiently to fill the dead space existing between itself and the rigid chest wall. Nature tries to diminish this space by contracting the chest wall so that the ribs almost overlap and in many cases there are no intercostal spaces except at the insertion of the ribs at the spine. The diaphragm very often is drawn up two or three inches in its attempt to obliterate the space. The pleura also thickens and diminishes this space to a certain degree. Nevertheless there often remains a cavity holding two or three hundred cubic centimeters of fluid.

- 2 The pleura often contains micro organisms which cannot be reached by flushing with any antiseptic solution and thus the secretion of pus continues indefinitely.

- 3 At times there are foreign bodies present such as rubber tubing which has slipped in unknown to the surgeon and remained there keeping up suppuration.

- 4 In cases of abscess of the lung the tendency to non closure is greater because there is usually a communication with the bronchus which is very often dilated and reinfection of the abscess cavity after drainage keeps up the suppuration.

- 5 These chronic suppurative abscesses are often multiple and when one or two are opened the drainage and suppuration persist in many small recesses and only communicate through the branches of the bronchi.

- 6 In abscesses due to tuberculosis of the lung the reason for non closure is still more apparent when we consider the pathology of the tuberculous lobe.

Bearing in mind these various causes for non closure, the treatment in each case will naturally consist in removal of the cause if this be possible. If the cause is not removable as for instance the extreme size of the pus cavity we are face to face with a most difficult situation. The patient has then the choice either of enduring his trouble and being satisfied with daily dressings or of taking the risk of an extensive operation.

#### WHAT SHALL BE DONE WITH CHRONIC SUPPURATIVE CASES WHICH PERSIST IN SPITE OF TREATMENT?

During the past seven years I have employed a method of obliterating these very large cavities or those which persist in discharging on account of communication with the bronchus which I believe is simpler and less dangerous than the extensive Estlander Schede or decortication of the lung. I have described the same in full in the March, 1918, number of *SURGERY, GYNECOLOGY AND OBSTETRICS* p 259 but since then I have introduced new features in this operation and in order to make the subject here complete I will recapitulate the essential points of this rather new procedure. I am informed by a number of confreres who have already employed this operation that they have found it very satisfactory.

#### SKIN SLIDING OPERATION FOR EMPYEMA

This procedure aims at the obliteration of the pleural space, as does the Estlander or similar operations. It differs however in this respect that in the skin sliding operation we transform the suppurating cavity into a skin covered surface so that it is a continuation of the outer chest wall while in the other procedures an attempt is made at re expanding the lung or caving in of the chest wall to meet the retracted lung.

This epidermization of the exposed lung is accomplished by removing as much as possible of the muscles ribs and the thick parietal pleura over the pleural dead space.

exposing thereby the retracted lung surface and then initiating the growth of skin over the exposed lung by shifting a long skin flap into the deepest recess within the pleural space. This skin flap will serve as a starting point for the regeneration of the skin from its edges until the entire denuded surface is covered by an epithelial growth.

The regeneration of the skin from the edges will take place only if we prevent the granulations from rising too high above the level of the skin edge and for this purpose we have introduced the adhesive plaster method for regeneration of the skin described below.

The size and shape of the skin flap should be planned beforehand and the incision made accordingly. In most cases I have employed a  $\lambda$  shaped incision which produces really three flaps as shown in Figure 21. Flap A is longer and narrower and is intended for the deep recess in the apex while flap B and flap C have obtuse angles and will usually reflect over the dome of the diaphragm and the mediastinum. In other cases different incisions such as the  $\lambda$  incision or the trap door incision may be more suitable. These are also illustrated in Figure 21. In order to review the technique of this operation I cite from my previous publication:

The patient is placed in a semi-recumbent posture and is anesthetized either by local or general anæsthesia. Before incising the skin a rubber catheter is introduced into the existing sinus and kept there as a guide. The incision is then made to suit the individual case choosing one of the incisions illustrated in Figure 21. The flaps at first contain the skin, fat and muscles in order that the skin may keep its circulation until it is ready to be inserted. Then follows the resection of as many ribs as seems necessary to expose the lung to its fullest extent. Three to five is usually sufficient. This should include as a rule the third rib because this gives us access to the deepest part of the cavity and facilitates the insertion of the flap into the same. The greater part of the pectoral muscles must often be divided or dissected to make the exposure sufficient. A straight incision is then made upward through the pleura starting from the sinus

in which we have placed the catheter and carried to the highest point possible up to the second rib. The edges of the thickened pleura are then retracted by strong Volkmann forceps and the cavity inspected. All of the parietal pleura is now dissected away clear to the edges of the dissected rib on either side but no attempt is made to peel off any of the visceral pleura or to resect the parietal pleura covering the first or second ribs at the apex. The muscles and fat are now freed from the skin flap and cut off. The tip of the skin flap is then grasped by an artery forceps and carried to the farthest point upward into the deepest part of the cavity so that its raw undersurface lies snugly against the parietal pleura underneath the first and second ribs. Gauze is packed rather tightly against it to keep it in place. In order to prevent retraction of the skin flap the forceps may be kept *in situ* for 4 hours the gauze packing keeping it in place. Another precaution may be taken by fastening the skin by means of a stitch taken through the base of the skin flap to the tissues over the second or third rib. It may be advisable to introduce a small drain beneath the base of the skin flap to prevent the possibility of suppuration underneath the flap. At this stage the operation is completed. The two lower skin flaps require no special attention they will adjust themselves.

During the entire procedure it is rarely necessary to use any suture material. The operation should not take more than 100 minutes in the more extensive cases and can be done in less than 60 minutes in the less extensive ones.

*After treatment.* The packing should not be removed for 48 hours. By this time the flap will be firmly adherent. It is best however to take the precaution to keep a spatula in contact with the skin flap so that it will not be torn off in removing the gauze. The removal of dry gauze may sometimes be so painful as to necessitate a gas anæsthesia and for this reason we introduce at the second dressing gauze strips which have been soaked in vaseline. Within one week the raw surfaces including those which have been caused by the denudation of the skin will be covered

sufficiently by granulations to begin the application of adhesive strips for skin regeneration. The method is as follows:

*The zinc oxide adhesive plaster as an aid to skin regeneration.* This consists in pasting adhesive plaster strips about a half to three quarters of an inch in width along the edges of the granulating wounds so that the margin of the skin as well as the granulation surface is covered (Fig 19). The adhesive plaster serves the same principle that wire does for a vine: the granulations will be kept down to the level of the margin of the skin and the epithelial cells will regenerate along the under surface of the adhesive plaster (Fig 2). On removing the first dressing of the adhesive strips we will note a bluish margin along the edges of the skin which represents the new growth of cells during the twenty four hours. The adhesive plaster is not put on at the next dressing but plain gauze is applied in order to give the newly formed growth a chance to become more substantial. Thus the adhesive plaster is applied every second dressing or every forty eight hours alternating with gauze dressings.

It has been questioned whether a true regeneration of epithelial cells takes place since some of the new formed skin resembles scar tissue. We have proved beyond doubt that true regeneration of epithelium does take place which proof will be published in a special article. However we here wish to illustrate the microscopic sections of some of the newly formed skin removed from cases in which we performed secondary operations in which epithelial regeneration took place (Fig 23).

For illustration of the skin flap operation I desire to cite two typical cases.

**CASE 1** *Chronic empyema* 10 years duration with drainage. Miss F. L. age 10 developed an empyema on the right side at the age of 3. This was drained and she was apparently well until she was 14 then she developed fever and pain in the right chest. The chest was reopened and large quantities of pus evacuated whereupon the wound healed again. Shortly after fever again developed and it was then advised to drain permanently as shown in Figure 20.

She came under the care of my brother Carl Beck in June 1915. Injections of bismuth were

tried for a time and the condition improved but the cavity was so extremely large that a permanent obliteration could not be expected (Fig 24). Therefore on February 1916 Carl Beck performed a modified Schede operation. A circular flap and the muscle were dissected down to the ribs and a part of the fourth fifth sixth and seventh ribs was resected anteriorly. The pleura was then incised at the seventh rib where drainage had been established and the incision continued up to the third rib. The cavity was packed with several pieces of gauze and the wound temporarily closed with three stitches of catgut.

The second step of the operation was done ten days later and this consisted in trying to obliterate the space by pressing in the right breast. This procedure however was not found effective since the cavity itself reached far into the apex and besides the pleura was constantly secreting pus. He therefore decided to denude the skin from the breast making a large size flap amputating the breast and the pectoral muscles and shifting the skin flap up into the apex. This was done in May 1916. No attempt made to produce lateral flaps.

The entire denuded area was left uncovered for the adhesive plaster method of reconstruction of the skin (Plate IV). Healing took place rapidly and with the aid of adhesive plaster the entire cavity was now lined with skin entirely dry and the girl is in perfect health and able to do general housework. She has no deformity of the spine only the unsightly depression in her right chest wall (Plate V) which of course is only visible when she is undressed.

**CASE 2** *Chronic empyema* draining 3 years complicated with acute influenza pneumonia.

A Bulgarian laborer S. K. age 33 developed empyema in 1915 and drainage was performed two weeks after an illness which was probably pneumonia. This left a small sinus draining anteriorly as shown in Figure 5.

The previous treatment of this case consisted in irrigations and also injections of bismuth paste (Fig 28) which improved it for six months during which time the sinus was closed and then reopened. It was finally decided to do a skin sliding operation. A Y shaped incision was made such as is shown in Figure 25. The two principal steps in the operation are illustrated in Figures 26 and 27. The first one illustrates the resection of the skin flap including the muscles (for those are not to be removed until the skin is to be shifted into the cavity) the pleura is already opened and we notice the floating pus within. In the second we have already dissected away the muscles and widely exposed the pleural cavity. The skin flap here is being held up by two forceps. This upper flap was inverted and pushed against the under surface of the remaining chest wall thus adhering to the parietal pleura. The entire cavity was then packed snugly with gauze to keep the skin in close contact with the pleural surface and favor adhesion.

operated upon one was twenty five hours old. Among the records of Cook County Hospital several cases are included in which the perforation was a number of days old in these instances the perforation must have been incomplete giving time for walling off processes to develop. Here actual suppuration might easily have been prevented and drainage of the local abscess justified.

First then I should conclude that drainage is almost always uncalled for in early perforations of gastric or duodenal ulcers. Drainage may be indicated (1) in late cases (after 18 hours) (2) the rare instance of inadequate closure of the perforation due to physical inability adequately to invert the lesion and (3) where gross masses of stomach contents are spilled into the peritoneum.

*Gastro enterostomy.* Is a gastro enterostomy called for after closing a perforated ulcer? Diametrically opposite views are presented in a most arbitrary manner. Denver always does a gastro enterostomy others never do a gastro enterostomy. It seems to me that gastro enterostomy has a double function to perform first and obviously to relieve existing obstruction due to the inversion of the ulcer and second and of fundamental importance the therapy of the existing lesions in the stomach.

First of these the relief of obstruction applies only to duodenal and pyloric ulcers. When adequately inverted these should almost always produce obstruction. It is no evidence of skill that such an obstruction is avoided rather it is frequently an evidence of inadequate inversion of the calloused ulcer. Moreover that clinical patency is found to be present when at operation obstruction seemed likely is evidence only that the stomach is capable of compensating for a high degree of obstruction which it should not be called upon to do as we hope to show.

*The therapy of the existing stomach lesions.* It is agreed that the perforation is one of the surest cures for gastric ulcers. It is a cure for the ulcer involved in a limited number of cases (70 per cent — Pater son) but in from 0 per cent to 50 per cent of the cases of active ulcer causing perforation the lesion is multiple. The autop-

sy findings at Cook County Hospital are incomplete on this phase of the subject the only patient of my series who came to autopsy showed seven active ulcers two besides that which perforated were extensively necrotic four were in various stages of activity. The value of jejunostomy in such a case can hardly be overestimated not merely its late effect but its immediate action on the perforation and on the active ulcers.

There is a note in some of the records that the stomach wall is found too friable for suture. Such a statement is evidence that the operator lacks a proper apprehension of the principles underlying the closure of a perforated ulcer. The perforation is but a small portion of the gross ulcer. In closing the perforation the entire ulcer should be embedded. It is for this reason that the lumen of the pylorus and duodenum will usually be closed if an ulcer is adequately enfolded.

*Excision of the ulcer.* Excision of the ulcer its closure with free facial transplants the cauterization of the perforation etc. are all unnecessary complications of the technique of treatment. In the presence of an emergency fraught with danger the unnecessary additions to the operation are uncalled for. Through and through suture grasping the entire ulcer as well as the perforation is effective in destroying the lesion.

#### THE OPERATOR'S TECHNIQUE

*Technique* after all plays an important part in results irrespective of the type of operation followed. Although there is found to be a benign peritonitis during the early hours following the perforation the abdominal viscera will not withstand excessive traumatism. Whatever operation is done it must be carried out with a minimum of handling of the parts. The statement contents poured from the perforation while the stomach was being drawn from the abdomen is evidence of poor technique. The rate of traumatism per minute inflicted upon a patient if it could be indicated by a definite unit of measurement would surely be found to vary 1000 per cent in the hands of different operators and this materially influences results. A further evidence that the operator's technique plays

quite as important a role in mortality as his method of treating the perforation is indicated by the fact that several series of perforations have been reported in which the mortality was low though some were treated by gastro-enterostomy and others not. Examples of this are Deaver's statistics of 40-odd cases with one death in all of which he did a gastro-enterostomy and the work of others in which gastro-enterostomies were not done and in which the mortality was almost equally low. The elements of technique which play an important role in the mortality may be covered in a few words. First the incision should be ample to afford the operator easy access to the upper abdomen. The pyloric end of the stomach and duodenum must be so exposed that they can be viewed *in situ* with a minimum of disturbance. Such an exposure enables the operator to find the perforation without loss of time and what is more important without pulling the parts out of their normal position.

It is said to be difficult at times to find the perforation and it has been suggested to give methylene blue in order to facilitate locating it. In three cases among the 50 operated upon in Cook County Hospital it is noted that the perforation was not found during the operation. I have had no experience of this kind and I think it likely that a free exposure would practically obviate its occurrence.

Upon locating the perforation if leakage is taking place a finger should be placed upon it until a through and through running suture can be so placed as to whip it in. There is no occasion for any special type of suture. The object is immediately to close the leak. The

perforation and the ulcer of which it is a small part should now be thoroughly infolded with as many sutures as are required adequately to accomplish the purpose. When the perforation lies close to the pylorus and the area of induration is wide it may be desirable to turn the first portion of the duodenum acutely upon the stomach and suture it there. The essential step at this part of the technique is to bring good broad peritoneal surfaces together. Fowler's position nothing by mouth and the use of large quantities of water per rectum constitute an important part of the after treatment.

Of the 17 cases personally operated upon drainage was instituted in 6 or 7 of the cases being used in all of the earlier cases. In all but one instance where drainage was used it was through an extra suprapubic incision. In one case drainage was carried down to the perforation itself. In this case the perforation opened up within 48 hours and all stomach contents were discharged almost as quickly as swallowed. The patient died within a few days and this constituted the only operative death in 16 consecutive cases. In one case in which drainage was not instituted a subphrenic abscess formed followed by a pleural empyema. This patient died in the fourth week following operation after making a prompt primary recovery. The extension of the infection to the pleura was probably due to inadequate drainage of the subphrenic abscess. The seventeenth case of the series died of a generalized peritonitis. Examination at autopsy showed the presence of seven active gastric ulcers.

## ARE WE JUSTIFIED IN REMOVING A COMPARATIVELY HEALTHY GALL-BLADDER<sup>1</sup>

By W H MAGIE MD FACS DULUTH MINNESOTA

**T**HIS short paper is based upon my personal experience in three hundred operations upon the gall bladder and bile ducts

There has been and still is quite an animated discussion going on as to the relative value of cholecystostomy and cholecystectomy. There is no doubt that both methods of securing the same result have their advantages in properly selected cases. While looking over the literature of surgery of the gall bladder one is impressed with the wide difference of opinion existing among different authors. There is no department of surgery in which there is a greater difference of opinion than in surgery of the gall bladder.

My object in presenting this paper is to make a plea in favor of saving the gall bladder in at least a majority of the cases. The physiologists as well as surgeons are of the opinion that the gall bladder has a function and when we admit it has a function we are compelled to admit that function whatever it may be should be conserved. It is claimed that its chief function is the storage of bile and that the bile while in the gall bladder undergoes certain chemical changes that better fits it to participate in the processes of digestion and that at certain intervals this bile is discharged into the duodenum. These intervals correspond with the early stages of digestion. Again there is another theory more recently put forward concerning an additional function of the gall bladder that it acts as a pressure gauge keeping up the intrabiliary pressure. That the gall bladder has a function of storing bile there can be no doubt. I have never seen an empty or collapsed gall bladder when examining it during the course of operations in the upper abdomen. The fact that it is always filled with bile goes to prove that it has much to do with keeping up and regulating the pressure in the bile ducts and liver. This theory is supported by the results of experiments upon animals.

Eisendrath and others have shown that when the gall bladder is removed in dogs the remaining cystic duct dilates as do the common and hepatic ducts. The dilatation of the cystic duct takes on the appearance of nature making an effort to reproduce the gall bladder. This same dilatation of the cystic duct has been observed in man after cholecystectomy. This effort of nature to reproduce the gall bladder is evidence that the gall bladder not only has the function of storing bile but also has a pressure regulation function upon the biliary system. These facts should be taken into consideration where the question of cholecystectomy versus cholecystostomy is to be decided.

Some years ago while discussing the relative merits of cholecystectomy versus cholecystostomy with one of the most popular surgeons of this country he made the statement that every gall bladder that could be saved should be saved that removing the gall bladder is like burning the bridges behind an advancing army that it was valuable for drainage purposes especially in cases of cholecystitis accompanied by cholangitis with swelling and plugging of the hepatic ducts as well as the common and cystic ducts with tarry bile.

Two years ago while visiting this surgeon at his clinic I saw him remove what looked to me very much like a normal gall bladder. In reply to my question as to what percentage of gall bladders he removed he stated about 97 per cent. This answer was a very unexpected one although I knew that his mind had greatly changed during the intervening years. The more we study statistics of gall bladder surgery the more confused we become due to the fact that there is a wide difference in results even among the very best surgeons in our country as well as surgeons of the countries across the Atlantic. To account for this wide difference of opinion is impossible. One class of surgeons has ability

and experience equal to that of the other class but still results are very widely apart. How can we reconcile these widely divergent results? Probably as in the case of the surgeon who informs me that he had to reoperate about one third of his cholecystostomies he left many gall bladders that should have been removed at the first operation.

The first object we wish to obtain in many of these cases is the saving of human life as many of these cases are very seriously ill when they reach the surgeon's hands. When to operate in many cases is a very important question and the outcome will depend on a decision as to the most opportune time for operation. An inopportune time for operation may account for the great difference in the percentage of mortality reported by different surgeons.

One of the most remarkable things I have observed is the great recuperative power the gall bladder possesses. In my early experience before we were removing as many gall bladders as we are now we were astonished to see a great majority of our empyemic gall bladders get well and stay well after drainage. If such results can be obtained from empyemic gall bladders we surely can expect a mildly diseased one to recover and become again a functioning organ.

It is generally conceded that cholecystectomy has much greater mortality than cholecystostomy. If so then this consideration also should bear weight in making up our decision. Personally I have had no mortality in my cholecystostomies while on the other hand my mortality following cholecystectomy has been about the average mortality if not greater than that of other surgeons.


Recognizing the fact that the gall bladder is not a vital organ and that man seems to get along very well without it it still may be true that our patient does not get along so well without it as if he had it still functioning. Owing to the great difficulty in following up our cases this question is often a very hard one to decide. The facts are that we have no means of knowing how much better off a patient might have been if the gall bladder had not been removed. Again as to the morbidity following cholecystos-

tomy we encounter a wide difference of opinion. One surgeon makes a statement that

fully one third of his cases treated by cholecystostomy had to be reoperated upon others have put the percentage of reoperated cases as low as 5 per cent. In my own experience my cholecystostomy cases have not required reoperating in more than 5 per cent and in every case where reoperation was necessary it was on account of overlooked stones or stricture of cystic duct. In case of overlooked stones the gall bladder was simply reopened and stones removed and drained as before. In case of cystic duct obstruction either an anastomosis with the duodenum was made or the gall bladder removed.

I am of the opinion that long continued drainage followed with daily irrigation of the gall bladder after the removal of the drainage tube contributes greatly to the thorough and complete cure of the pathological condition. Irrigation is also desirable for the purpose of washing out any overlooked stones that may have been left. I have on several occasions washed out or at least have had stones present themselves at the gall bladder sinus as large as a good sized marble when they were easily removed. That drainage also has a good effect in the cases complicated with cholangitis when the ducts are clogged with thick tarry bile there can be no doubt.

What are the indications for cholecystostomy? In the writer's experience all cases of acute cholecystitis of only a few days duration also some cases of acute cholecystitis that have had previous attacks provided the gall bladder walls are not much thickened and free from adhesions that would indicate previous serious attacks provided also that the cystic duct is open and gall bladder contains bile. Many acute gall bladders contain but little bile at operation due to swelling of cystic duct but within a day or two after drainage is established and sufficient time has elapsed for the swelling to have been reduced the bile escapes freely through the drainage tube. All cases of simple cholelithiasis when gall bladder shows little signs of ever having been infected and when exploration of the interior shows a comparatively healthy mucous membrane.





When should cholecystectomy be resorted to? (1) In all cases of hydrops with tricture of the cystic duct (2) in many cases of acute gangrene or threatened gangrene of the gall bladder (3) in all cases complicated with imbedded stones in the cystic duct with ulceration produced by contact with the imbedded

stone that when healed would probably cause stricture (4) in all very thick walled gall bladders due to fibrous or calcareous degeneration (5) in all cases of ulceration due to pressure of large stones (6) in cancer of the gall bladder where the disease is limited to the gall bladder

## PAROTITIS AS A POSTOPERATIVE COMPLICATION<sup>1</sup>

By CLIFFORD U. COLLINS, M.D., PEORIA, ILLINOIS

IN the year 1915 four of our patients developed parotitis and three of them died. This was considered a sufficient reason for making a study of the subject which was done. The thing that were learned from that study seemed to be valuable because we have had only two cases of parotitis since both postoperative and neither one died.

First we went over our records and found that in six thousand one hundred patients who had been operated on seven had developed parotitis and one patient developed parotitis and died while waiting for operation. A study of the disease was made which follows.

All of these eight patients had been in the same hospital which had no special significance we thought because practically all of our operative work is done at this hospital. Five were male and three were females. All of these eight patients had had abdominal operations except one and he had an abdominal infection peritonitis following appendicitis. Three were operated on for obstruction of the bowels, two were operated on for ulcer of the stomach, one had a pinhysterectomy done and two had peritonitis. Two of the patients had fecal fistulas and one had a colostomy when the parotitis developed. In five patients both glands were inflamed and in three patients the right gland only was affected. Five patients died while three recovered. Of the five that died three had abdominal conditions that might have caused death anyway but in two of the five patients the

parotitis was evidently the principal cause of death.

In six of the patients there was no positive evidence of suppuration in the glands. Two recovered without suppuration and four died. Of the four that died three died in such a short time after the parotitis developed that there was hardly time for suppuration to become manifest. In two of the patients suppuration became apparent and the glands were drained.

It was deemed significant that seven of the patients had had abdominal operation and the other one had an abdominal infection peritonitis. The seven patients operated on had received scopolamine  $\frac{1}{4}$  grain and morphine  $\frac{1}{2}$  grain as a preliminary hypodermic before the operation. As is well known scopolamine dries up the secretions of the mouth and salivary gland. But one patient had not been operated on and had not received scopolamine. So evidently scopolamine was not a factor in the production of parotitis in that patient. All of the patients had been on the Ochsner treatment and nothing had been administered by the mouth for several days. An effort had been made to supply the patients with sufficient water by administering salt solution and bicarbonate of soda solution per rectum.

After a study had been made of our case record a study was made of the literature. Nearly all of the cases of post operative parotitis reported in the literature followed abdominal operations. This seemed to be significant.

One of the most interesting articles we found was by H B Rolleston and M W B Oliver<sup>1</sup> They studied 1000 cases of gastric ulcer treated in St George's Hospital in twenty years from 1889 to 1908 These patients were all treated medically and not surgically In 470 patients treated by oral starvation there were 21 cases of parotitis or 4.5 per cent while in 530 patients who were allowed something by mouth there were two cases of parotitis or 0.4 per cent These two patients were on rectal feeding but had been allowed to suck a little ice It should be noticed that these patients were suffering from an abdominal condition gastric ulcer that food and drink had been interdicted by the mouth in practically all of them and none of them had been operated on It is evident therefore that some factor other than something pertaining to a surgical operation was a cause of the trouble in these patients The authors sum up their conclusions as follows

1 Secondary parotitis may complicate cases of gastric ulcer treated medically by oral starvation

That it occurs ten and a half times more frequently in such cases of gastric ulcer than in cases allowed fluid by the mouth

3 That it is an outcome of the dry condition of the mouth and that mouth washes do not prevent its recurrence

4 That it is more often unilateral than bilateral

5 That suppuration occurs in about one fourth of the cases and that this constitutes a grave complication

Curiously enough there is an article in the same journal by W S Fenwick entitled

The Prevention of Parotitis during Rectal Feeding<sup>2</sup> He believes that the infection ascends Stenson's ducts He tried various measures to keep the mouth clean during the rectal feeding but they were not successful Then he made an effort to promote a continuous flow of saliva by having the patient chew horse radish pieces of raw meat at intervals or keep a pebble constantly in the mouth He finally had the patients suck an India rubber teat about two inches long which produced the

desired effect He said the patients sucked the teat for hours at a time and thus kept the mouth clean and moist After he adopted this method he treated more than 500 cases of hematemesis by rectal alimentation without being troubled in a single instance by parotitis

An article by Jacob Frank<sup>3</sup> discusses the different theories and sums up as follows

1 That it is highly probable that secondary parotitis is due to an ascending infection of Stenson's duct

2 That the onset of this complication may be prevented by attending to the following details (a) mouth carefully cleansed before and after operation (b) everything used for the anæsthetic should be sterile (c) the anæsthetizer should avoid pressure on the gland while attempting to elevate the jaws during anæsthesia

3 When the swelling does not show any tendency to decrease in size in about four days it is advisable not to wait for fluctuation as the location of the pus is beneath the dense parotid fascia Therefore free incision and drainage should be resorted to early

From the study of our cases we are inclined to agree with Frank's conclusion that the cause is usually an ascending infection from the mouth All of our patients had been on the Ochsner treatment and fluids had been withheld by the mouth Two of our patients had a fistula of the small intestine which allowed the liquid contents of the small intestine to escape before the fluid portion was absorbed Both of these patients died We became convinced that the parotid glands in our patients had become inactive because nothing had been taken into the mouth to excite activity of the gland and that this inactivity predisposed the gland to infection We also became convinced that our patients had not received enough fluid and this further contributed to inactivity of the parotid glands and dryness of the mouth A study of the practical results of trying to give fluids per rectum convinced us that the patient did not get near as much fluid by that method of administration as we had tried to make ourselves believe that he did When we put good

honest nurses in charge of the proctoclysis and received honest reports we found that about half of the patients retained very little if any of the fluid. The remaining half of the patients retained perhaps half of the amount of the fluid administered. After two or three days administration the rectum usually becomes irritable and retains none of the fluid. At least this has been my experience and I would like to know whether I am alone in this experience.

So we decided that our first problem was to keep the parotid gland actively secreting and passing a current of secretion down Stenson's duct into the mouth and our second problem was to keep the patient's body supplied with sufficient fluid.

In solving the first problem we tried the use of chewing gum but it did not seem to work well. Perhaps the ingredients of the brands of chewing gum defeated our purpose. At any rate we discarded chewing gum after a trial with it. Then we tried letting the patients chew on a rubber nipple following the suggestion made by the English author quoted above. While we were doing this a colleague called attention to the fact that acids excited the parotid gland secretion as evidenced by the diagnostic measure of having a patient suspected of having mumps try to eat a sour pickle and suggested the use of acids. We then tried putting a lemon drop in the nipple. Finally we gave the patients old fashioned lemon stick candy to suck and that gave the best results. Whenever it is deemed best to withhold food and drink by the mouth for a time as in stomach operations, peritonitis or paralytic ileus for example the patient is given a stick of lemon candy to suck but not to eat. It excites a flow of saliva and keeps the parotid gland active. Observation has seemed to show that there is not enough secretion swallowed at one time to excite peristalsis of the stomach or bowels. At least the patients did not complain of peristaltic pains while using the candy.

The second problem of supplying the patient with sufficient fluid was solved by following the suggestion of Kanavel and putting the hypodermoclysis needles in the axillæ

and leaving them *in situ* as long as necessary in order to save the patient the pain of reinsertion. A pint of normal salt solution may be given every three or four hours in this manner and you know that the patient's body receives the entire amount of the fluid. We have left the needles in four or five days and the patients did not complain of discomfort. Incidentally we believe that in our practice this measure has saved lives in other conditions as well as postoperative parotitis. Some times we keep the solution going continuously through the needles into the tissues for several hours.

If the inflammation has not been prevented by the above means a free incision with adequate drainage should be instituted early in about four days if the inflammation is not subsiding by that time. The capsule or fascia covering the gland is so dense that it takes a long time for the pus to work through and give evidence of its presence on the surface of the skin. It usually works along beneath the fascia and breaks into the external auditory canal.

Vilray P. Blair makes a plea for the early institution of surgical treatment on the third or fourth day and shows a cut of the incision he uses. He claims that this incision heals spontaneously with a hardly noticeable scar. This incision has been used by the writer a few times and the results so far corroborate the claims of Blair.

#### CONCLUSIONS

- 1 Postoperative parotitis is more apt to occur after abdominal operations than operations on any other part of the body.
- 2 Its development is favored by a dry condition of the mouth and a lack of fluids in the body.
- 3 The infection usually ascends through Stenson's duct.
- 4 In patients whose abdominal condition makes it necessary to withhold food and drink from the mouth and stomach for a time prophylactic treatment should be instituted.
- 5 The mouth should be kept clean and moist by its own secretions and the body should be abundantly supplied with water.

6 A good way to excite the secretions of the mouth and to keep a current of saliva flowing *down* Stenson's duct is to allow the patient to *suck* on a stick of lemon candy after operation

7 A very accurate and effective way to supply the body with fluid is to administer salt solution by hypodermoclysis. If this is done according to Kanavel's directions there

will be no pain in the administration and very little discomfort

8 If the prophylactic treatment fails and parotitis develops and the inflammation is increasing or is no better by the third or fourth day the gland should be uncovered by a free incision and punctured in several places with blunt forceps and the incision packed with wet sterile gauze as suggested by Blair

## OBSERVATIONS REGARDING THE INDICATIONS FOR THE OPERATION OF CRANIAL DECOMPRESSION

By WILLIAM SHARPE, M.D., NEW YORK

P f e s s o r i n I n t e r n a l M e d i c i n e, N e w Y o r k P o s t g r a d u a t e M e d i c a l S c h o o l, D e l a w a r e

THE operation of cranial decompression has been so frequently misinterpreted and even confused with other cranial operations that it seems advisable to state its indications and contra indications and to describe the type of decompression with its most satisfactory technique

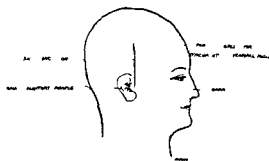
As is indicated by the name of the operation a cranial decompression presupposes the presence of an increased intracranial pressure. If there is not present an increased intracranial pressure then the operation can not be described as a decompression but rather as a craniotomy (if the bone flap is replaced) or a craniectomy (if the bone flap is permanently removed). In the recent literature the term decompression is commonly used to indicate merely a trephine opening and in many instances the dura not even opened or allowed to remain opened. Surely a small trephine opening in itself with the dura opened may theoretically be to a certain extent a decompression but its decompressive effect is practically almost negligible again to replace a bone flap even though the dura is allowed to remain open is not a decompression because the decompressive effect of the operation is nullified. It would seem therefore that the three qualifications essential to a cranial decompression (in order that it be correctly considered as such) are

1 The presence of an increased intracranial pressure

2 The removal of a large area of the vault—usually 3 inches in diameter

3 The dura to be opened and allowed to remain open as the dura is inelastic in adults no decompressive effect can be obtained unless the dura is opened and if a permanent decompression is desired then the dural opening must not be resutured but allowed to remain open

Cranial decompressions were commonly performed in the past over the upper areas of the vault. Many disasters resulted from this procedure in fact the operation of cranial decompression for this reason was practically discredited and it remained an operation of the last resort until Cushing placed the operation upon a rational basis. In patients having a marked increase of the intracranial pressure as in brain tumor not only was the operative damage to the underlying highly developed cerebral cortex a frequent result of such decompressions situated over the upper portions of the vault and thus followed by paralysis, impairment of the special senses and only too frequently the immediate death of the patient but the insecure closure of the operative wound (merely covered by the scalp) permitted huge herniae cerebri to occur and only too frequently their end result fungi cerebri and the death of the patient after months of a vegetative existence. It is no surprise therefore that a few years ago the operation



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of cranial decompression was avoided as long as possible—even at the risk of the delay producing an impaired vision and even blindness itself and it is this transmitted dread and fear of cranial operations that have retarded the development of brain surgery possibly more than any other factor. Cranial operations as now performed are no longer such extreme risks while the operation of cranial decompression is in itself no greater risk than the usual abdominal operation. This advance is due chiefly to better team work of the surgeon and the neurologist, a more practical conception of the purpose of the operation of cranial decompression and then a most important factor in improved surgical technique.

The operation of cranial decompression may be considered a means solely of decompression then of decompression plus exploration and lastly of decompression plus drainage. The following intracranial conditions as benched by the operation of decompression may be classified briefly as follows:

#### A Decompression alone

##### 1 Brain tumors

##### 1 Irremovable tumors

##### a Large midbrain and basal tumors

##### b Large subcortical tumors the removal of which would produce grave impairments such as paralysis

Selected cases of cerebral spastic paralysis due to an intracranial hemorrhage at birth

#### B Decompression and exploration

1 Brain tumors—non localizable tumors usually situated in the frontal and temporosphenoidal lobes

Brain abscess—non localizable abscesses—usually situated in the temporo sphenoidal lobes

3 Selected cases of organic epilepsy—Jacksonian in type or associated with increased intracranial pressure

#### C Decompression and drainage

1 Brain injuries with or without a fracture of the skull

Hydrocephalus—either of the internal or of the more common external type

##### 3 Brain abscess

4 Early localized meningitis especially due to otitic infections

There are several other intracranial lesions for which the operation of cranial decompression has recently been advocated notably the condition of apoplexy. It is possible in rare and selected cases of cortical apoplexy alone and at times in ventricular hemorrhage (although the diagnosis and operative drainage should be almost immediate in order to have the patient survive) that the operation of cranial decompression and drainage might be considered in order to obtain the greatest ultimate improvement but to advise this operation for the usual form of epilepsy—the internal capsular type which occurs in 90 per cent of these patients—is a most unsurgical procedure not only do these latter patients not have an increased intracranial

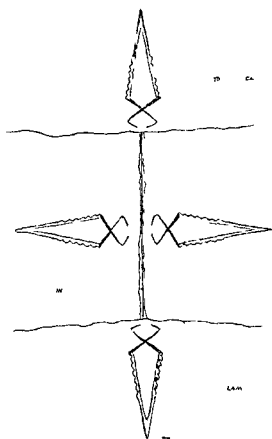


Fig. 3 The method of covering the skin (and thereby lessening the danger of infection) by clamping the towels to the skin itself: a wider exposure of skin is not only not necessary but is dangerous. The lobe of the ear cannot be made surgically clean.

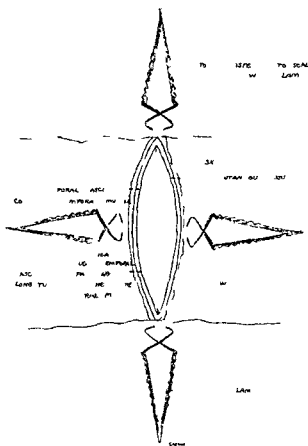


Fig 4 The skin incision down to the underlying temporal fascia. By the method of manual traction pressure upon the edges of the scalp incision the bleeding is practically nil. Small curved haemostats are now attached to the subcutaneous fascia and any possible bleeding points are compressed by the haemostat being turned down.

pressure and therefore the operation described in the literature cannot be a decompression but the operative damage resulting from the attempt to insert a needle into the internal capsule drain the hæmorrhage (even if it would drain) would be far greater than the impairment caused by the lesion itself besides some of the patients reported have been operated upon late when no drainage of the hæmorrhage would be possible and even in the early cases operated upon it must be remembered that the hæmorrhage into the internal capsule is not a free one but it is enmeshed among the capsular fibers giving the appearance almost of liver tissue and surely such hæmorrhage cannot be drained To advise therefore a cranial operation upon such patients merely because medical treatment has not caused a marked improvement is surely not rational surgery

There may be selected cases of acute cerebral oedema due to such toxic causes as occur in uræmia and certain other toxic conditions where after medical treatment has failed a cranial decompression might be advisable to lessen a high intracranial pressure and thus to a certain extent spare the vision and avoid a medullary compression and its resulting oedema—always fatal. No cranial operation however should be considered in these patients until repeated lumbar punctures have been proven inadequate. This work however is only in the experimental stage and must be considered as a possible aid only in very selected cases.

The cranial decompressions of choice are the subtemporal decompressions for supratentorial lesions and the suboccipital decompression for infratentorial lesions. Naturally the subtemporal decompression as a decom-

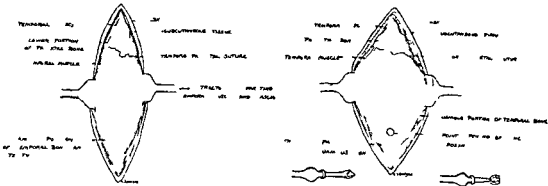


Fig 5 At th th t p t f th q m b th  
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b t d t m th bo

Fig 6 At th th t p t f th q m b th  
D y p e f at is d t m k p p o t p n  
l t the d d th th D y b t p l g  
th p g l t th d th t m l l g c  
b t d t m th bo

pression alone is of little or no benefit for intracranial lesions and should never be used in such conditions unless as a means of ventricular drainage (as in case of ventricular blockage) intracranial lesions such as cerebellar tumor and abscess are always more effectively treated by the suboccipital operation of decompression exploration and drainage. In this paper however the term cranial decompression means the subtemporal operation (the most satisfactory and effective method of decompression for supratentorial lesions the vertical incision alone is used) (The advantages of this method of cranial decompression are detailed at the end of the paper).

Let us consider briefly the three main purposes of the subtemporal decompressions

A. PRIMARILY AS A MEANS OF LESSENING AN INCREASED INTRACRANIAL PRESSURE

1. *Brain tumors* As the percentage of malignancy in brain tumors is high (almost 80 per cent) they naturally form a very discouraging part of brain surgery then again if the tumor is not malignant in itself yet it may be so situated in the mid brain or base that to remove it would either cause the immediate death of the patient or such a marked mental physical or sensory impairment that it would not be justifiable that is the condition of the patient might be worse than before the operation. It is not

creditable to brain surgery to remove the tumor (even if benign) if the mental and physical condition of the patient is worse than before the operation—the patient remaining a derelict.

It is in these very patients that in order to lessen the headache and to save the vision an early subtemporal decompression on one side and if necessary on both sides of the skull is most strongly to be advocated. Not only will the general condition of the patient be improved and blindness avoided but the tumor may not continue to enlarge and may remain stationary and even become smaller apparently and thus the patient be spared indefinitely. This is particularly true in young adults—the diagnosis being a tuberculoma of the mid brain the cedematous wet brain of the so-called pseudo-tumors might be also included. To allow these patients with a high degree of choked disc to develop a secondary optic atrophy and its resulting blindness merely because the tumor is considered an irremovable one or cannot be localized is an opinion that cannot be too strongly condemned. The operation of cranial decompression is no longer such a formidable procedure that it should be delayed and postponed until the life itself of the patient is endangered to operate upon these patients blinded by long continued intracranial pressure is most depressing and possibly hardly justifiable.

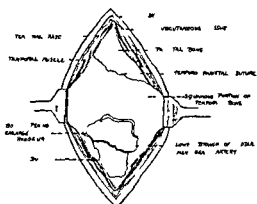


Fig. 7 (at left) Bony opening being enlarged by rongeurs back and downward and upward but not forward until last on account of the middle meningeal artery lying adjacent to the anterior portion of the bony exposure. If the artery should be in the hemorrhage can be very easily controlled either with bone wax, a silver clip or if necessary by a small packing of gauze tape.

*Selected cases of cerebral spastic paralysis due to an intracranial hemorrhage at birth.* These patients were formerly classed in that large group due to Little's disease and thus confused with cases of lack of development of the cerebral cortex and its pyramidal tracts and also with those cases resulting from a former meningo-encephalitis—an infectious destructive process and naturally conditions which cannot be benefited by any cranial operation. But patients having a spastic paralysis due to an intracranial hemorrhage at birth not only can be differentiated by the presence of an increased intracranial pressure as ascertained both by the ophthalmoscope and more accurately by a measurement of the pressure of the cerebrospinal fluid at lumbar puncture by means of the spinal mercurial manometer but those latter patients can be markedly improved by a lessening of this increased pressure by means of a simple subtemporal decompression. Naturally only those patients having an increased intracranial pressure can be benefited and are therefore the only ones that are operated upon out of a series now of almost 1800 patients that I have personally examined only 378 of them revealed the presence of an increased intracranial pres-

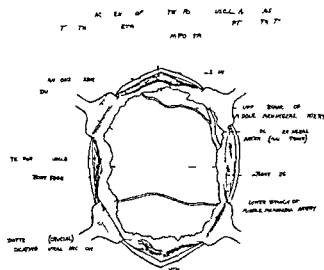


Fig. 8 Final size of bony opening about 3 inches in diameter. The underlying dura is now opened as widely as possible by crucial and later stellate incisions. The dural hook and grooved director are first used then the spoon spatula and dural scissors to enlarge the dural opening.

sure that is about one out of every five patients examined and these are the only ones for whom a cranial decompression can be of any benefit. The best results are obtained when the condition is diagnosed at the time of birth or shortly after it—and it very easily can be by the presence of blood under pressure in the cerebrospinal fluid at lumbar puncture then a modified cranial decompression with drainage of the free hemorrhage will in many cases obtain a normal child. (Even repeated lumbar punctures with drainage may suffice if the intracranial hemorrhage is not too large and the pressure too high in these latter cases of high intracranial pressure the cranial operation of opening the parieto-squamous suture combined with a modified subtemporal decompression and drainage is advisable the dura must always be opened.) The older the child the less is the improvement that can be ultimately obtained by the operation of merely lessening the increased intracranial pressure resulting from the earlier hemorrhage frequently a mild secondary external hydrocephalus results in these patients from the blockage of the stomata of exit of the cerebrospinal fluid in the cortical veins and sinuses this condition can be drained accord-



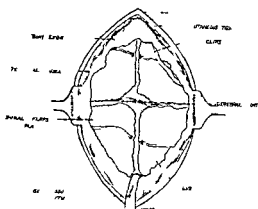
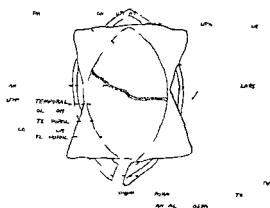


Figure 1. The phonetic transcription of the sentence "The cat sat on the mat" in the original speech signal. The transcription is shown in a grid format with the following structure:

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ingly at the same time by a modified decompression operation (vide Hydrocephalus)

The pathology of intracranial hæmorrhage in the patients is very instructive. It was formerly believed that the hæmorrhage always caused a primary destruction of brain tissue and therefore no regeneration being possible that these patients were all hopeless. As permission for a postmortem examination is obtained before operation upon each patient, it has been very surprising to ascertain either at the operation or at autopsy that the intracranial hæmorrhage caused a primary destruction of brain tissue in only 26 patients out of 364 patients operated upon—that is in only 7 per cent. The death rate of these operations was only 38 out of the series of 374 operated patients—that is a mortality of only 10+ per cent and a postmortem examination was made in each case. The hæmorrhage is almost always a supracortical one with later cystic formation so that the mental and physical impairments in these patients are due to the increased pressure of the overlying lesion—both a general and a localized increase of the intracranial pressure. It is the lessening of this increased intracranial pressure in these selected patients that permits a marked improvement in them both mentally and physically.

### B DECOMPRESSION PLUS EXPLORATION

1 *Brain tumors* Infratentorial growths are more easily localized than are the ones situated above the tentorium so that if the former cerebellar tumors can be excluded then it is a question of ascertaining the cerebral hemisphere in which the lesion is placed. At times the clinical signs point very clearly to the location in the hemisphere and yet only too frequently it cannot be definitely and accurately elicited. These are the patients who should not be permitted to develop a secondary optic atrophy and even blindness itself while an accurate localization in the hemisphere is being sought. An early subtemporal decompression will not only lessen the intracranial pressure but it will afford a practical means of locating the lesion by exploratory punctures—it being possible to explore carefully the entire ipsilateral hemisphere if the tumor is found (and it very frequently is found in the comparatively silent area of the temporo-sphenoidal lobe directly beneath the subtemporal incision so that it can be removed immediately). Then the proper method of removal can be used and if the tumor is not found (also unfortunately a frequent occurrence) then a decompression has at least been performed. The headaches improved and the vision spared so that a later localization of the tumor

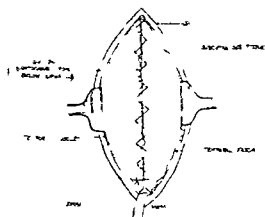


Fig 11

Fig 11 Continuous catgut suture (from below upward) is used to approximate the fibers of the temporal muscle over the bony opening.

Fig 12 Interrupted small black silk sutures alternating with the interrupted catgut sutures for closure of the temporal fascia making a firm approximation possible.



Fig 12

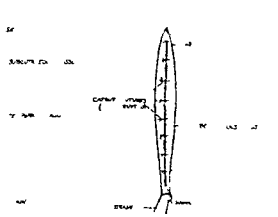


Fig 13

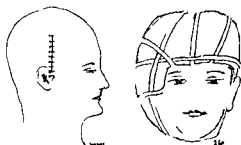
The silk sutures are permanent sutures and prevent an opening of the incision if the catgut sutures should be absorbed too early.

Fig 13 Subcutaneous fascia sutured with interrupted catgut continuous catgut (loosely) may be used in children in order to hasten closure in special cases.

may occur and its removal be possible and—the patient not blind. The lateral ventricle may also be tapped with a ventricular puncture needle to ascertain whether it is dilated or not; if dilated then the tumor would necessarily be either basal posteriorly or even subtentorial. Ventricular drainage temporarily might be instituted to improve the general condition of the patient until the tumor if subtentorial could be removed. To perform large osteoplastic flap operations over the parietal lobe in search of a tumor which may not be present even in the underlying hemisphere and if present then possibly at the base or in extreme frontal or occipital portions and very frequently in the lower portion of the temporosphenoidal lobes—situations requiring another incision and removal of bone in order to approach the tumor—such tremendous bone flap operations should never be performed unless it is surely known that the tumor can be removed through the incision; if the tumor is not found and the intracranial pressure is high then great difficulty will be encountered in making a firm closure without causing a definite damage to the more highly developed parietal cortex. In these cases a simple subtemporal decompression would permit an accurate localization of the tumor—whether

frontal occipital parietal, temporosphenoidal or basal—and then the tumor could be removed later through the appropriate incision.

2 *Brain abscess* The great majority of brain abscesses are cerebral and situated usually in the temporosphenoidal lobe adjacent to the ear involved—otic disease being the most common cause of brain abscess formations. As in brain tumors infratentorial cerebellar abscesses are more easily diagnosed than the supratentorial temporosphenoidal ones so that if cerebellar abscess can be excluded then the operative approach of choice is through the clean subtemporal area and not through the dirty infected field of the mastoid incision. All drainage operations for brain abscess are really exploratory procedures as the abscess may not be present or not found and if the dural incision has been made through the infected mastoid area then the danger of causing a diffuse meningitis is very great indeed. If however the subtemporal exposure has been made and if the abscess is not found then at least a decompression has been performed and the danger of a meningitis is slight and if the abscess is found then it can be freely and safely drained through the lower angle of the subtemporal incision. Not only does the decompression incision



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afford better drainage for the deeper sub cortical abscesses by means of the double glass tubes but the opportunity afforded of locating these deep abscesses is much greater and easier through the wider exposure of the decompression incision.

### 3 Select cases of epileptiform convulsions

—Jacksonian in type or associated with an increased intracranial pressure.

The surgical treatment of organic epilepsy is most discouraging and no cranial operation should ever be advised in cases of long standing in the belief that the condition can be cured. In only very selected cases of short duration where the attacks are definitely of the Jacksonian localizing type and where there is a marked increase of the intracranial pressure (still persisting after an interval of at least three months has elapsed since the last attack) is the operation of cranial decompression and exploration or any cranial operation justifiable even in the most carefully selected cases the results are not encouraging and yet good result and apparently even a cure is occasionally obtained in these patients. Cranial surgery however cannot be said to offer much hope to these patients except possibly to these very early selected patients as described above. To operate upon old chronic cases of whatever severity is hardly justifiable. Even the removal of the primary cause of the cortical irritation with its resulting convulsions—such as a cortical tumor old depressed fracture of the

vault and the cyst formation due to a former supracortical hemorrhage may result in only a temporary cessation of the convulsions in the older patients but these patients should be diagnosed early the irritating lesion removed and then the outlook is not so gloomy besides removing the lesion itself it is always wiser in these patients to relieve permanently the intracranial pressure due to the resulting cerebral edema of trauma by means of a subtemporal decompression.

### C DECOMPRESSION PLUS DRAINAGE

1 Brain injuries with or without a fracture of the skull. The mortality of brain injuries with or without a fracture of the skull has been notably decreased within the past decade the former death rate of 50 per cent and even higher has been reduced in several hospitals to 30 per cent and even lower. This marked improvement is due to a more general appreciation of the important factor of increased intracranial pressure in these patients and if present then the most satisfactory method of relieving it by means of the subtemporal decompression. As is well known it is not the fracture in the case nor the hemorrhage in itself that is so dangerous but rather the presence of a high intracranial pressure—whether due to hemorrhage or edema—and its consequent medullary compression and the only too frequently resulting medullary edema that render these cases so serious—not only as to life but also to their future normality.

Formerly the treatment of these patients had been so discouraging that it became a commonly accepted belief that they would all get along just as well without operation as with operation. This statement is perfectly true for over one half of the patients—there being no increased intracranial pressure in practically this percentage and naturally no operation (except in depressed fractures of the vault) would be indicated but of the remaining patients upon whom a cranial operation was performed the resulting high mortality—in many hospitals being 80 per cent and even higher—was due chiefly to the operative method used—in almost all

cases the extensive osteoplastic flap operation being performed and the dura very frequently not even being opened (and therefore no real decompression possible) or a small and totally inadequate trephine opening—the size of a one half dollar piece and even smaller being considered as a sufficient operative procedure—these two operative extremes—the former tremendous operation of great risk to these seriously injured patients and the latter so called operation of no possible or if possible then of very slight benefit to the patients—these two operations were usually performed either during the period of initial shock within a few hours after the injury when it is now realized that no operation should ever be performed as it is merely an added shock to the patient and takes away the patient's chance of surviving the shock or the operation was performed during the terminal period of medullary oedema in the hope that the patient would be given a chance to recover these patients when they have once reached this stage all die—operation or no operation. Naturally under these conditions the operative mortality was very high. More recent observations however in a series of over 500 patients have confirmed a growing belief in the following cardinal principles in treating brain injuries with or without a fracture of the skull<sup>1</sup>

1 All depressed fractures of the vault should be elevated or removed for fear of later complications particularly epilepsy.

2 The presence of a fracture in patients having brain injuries is not an important factor in their treatment the patients most seriously injured very commonly have no fracture at all and conversely the less serious of brain injuries are frequently associated with tremendous linear fractures of the vault—an important channel however of lessening an increased intracranial pressure by the drainage of free blood and excess cerebrospinal fluid or oedema and thus a cranial operation be avoided. Naturally basal fractures into the middle ear and especially into the nasal and pharyngeal cavities may permit an infective meningitis and yet this grave complication is comparatively rare.

3 The expectant palliative medical treatment of quiet ice helmet catharsis and liquid diet is sufficient for over one half of the patients having little or no increase of the intra cranial pressure.

4 A marked increase of the intracranial pressure (as revealed in slightly over one third of these patients by the ophthalmoscope and the measurement of the pressure of the cerebrospinal fluid at lumbar puncture by means of the spinal mercurial manometer) and *not* by the late and extreme pressure signs of medullary compression (such as a pulse rate of 50 and lower Cheyne Stokes respiration and pulse a high blood pressure and profound unconsciousness) should be lessened by a cranial decompression and drainage—not necessarily at the site of the fracture if present and by no means over the upper cortical areas but rather by means of the subtemporal decompression—the safest and most effective means of decompression drainage and closure possible in these patients. The dura must always be opened (except in the cases of simple extradural middle meningeal hemorrhage which are rare) and allowed to remain open for a permanent decompression and drainage of the consequent traumatic cerebral oedema so common in these patients. If the intracranial pressure is extremely high then a bilateral subtemporal decompression and drainage may be necessary—apparently in about 5 per cent of patients.

5 There are two periods in the treatment of these patients when no operation is advisable—no matter how seriously the patient is injured nor how high the intracranial pressure may be these periods are—first the stage of initial shock immediately following the brain injury when the pulse rate is 120 or higher any operation during this period of traumatic shock is merely an added shock to the patient and takes away the patient's chance of surviving the shock. If however he does survive the shock then he does so in spite of the operation and the second period in which no operation should be performed is the stage of medullary oedema—the terminal moribund period—operation or no operation when once the pulse has reached its lowest level of medul

lary compression and then begins to ascend rapidly to 100 120 140 and higher then an operation does not give the patient a chance (as formerly advocated) but merely hastens the exitus. If these two periods in the operative treatment of brain injuries are avoided and the latter of these—medullary oedema—usually can be anticipated then the mortality of brain injuries will be decreased to 30 per cent and even lower while the operation of decompression and drainage will cause not only the recovery of patients as to life but also as to their future normality.

*Hydrocephalus* both of the internal and also of the more common external type. A diffuse meningitis is the usual primary cause of this condition if the ventricles are blocked by exudate or adhesions in the aqueduct of Sylvius or at the foramina of Majendie and Luschka then the internal type of hydrocephalus results but if this ventricular blockage does not occur yet a hydrocephalus of the external type develops because the cerebrospinal fluid cannot be excreted as normally through the cortical veins and sinuses on account of their blockage by the former meningeal exudate.

In the operative treatment of hydrocephalus either of the internal or external type it is obvious that to drain merely the blocked cerebrospinal fluid of the ventricles into the subarachnoid or subdural spaces by means of corpus callosal punctures or tubes would even if these openings remained patent only change an internal hydrocephalus into an external one—with resulting little if any impairment. The object therefore of all operative procedures in these patients is to drain continuously and permanently the blocked cerebrospinal fluid beyond the cerebrospinal canal—that is into the blood stream (the ideal method and not yet practicable permanently) or into the extradural tissues such as the subcutaneous tissues of the scalp rich in lymphatics. The subtemporal decompression permits such drainage of the ventricles when blocked and of the subarachnoid and subdural spaces (in the more common type of external hydrocephalus) by means of several linen strands extending from the ventricles outward through the temporal lobe (a com-

paratively silent area) and from the subarachnoid and subdural spaces outward beyond the opened dura into the subcutaneous tissues of the scalp in a stellate manner.<sup>1</sup> At present this method of drainage through the subtemporal decompression assures an excellent drainage to all but apparently the most severe types of internal hydrocephalus naturally the earlier the operation is performed following the development of the hydrocephalic condition the greater is the chance of the child to approximate normality.

*3 Brain abscess* As stated above the usual type of brain abscess situated in the contiguous temporosphenoidal lobe following otitic disease is most safely and effectively drained through the lower angle of a clean subtemporal decompression by means of double glass tubes so that the inner tube may be used to drain the abscess while the outer tube remains always *in situ* and thus the abscess when once found is not lost. Apparently a large decompression opening tends to lessen the danger of a complicating meningo encephalitis—almost always fatal whereas the opening through the dirty field of the mastoid not only increases the danger and lessens the opportunity of a careful exploration of the adjacent brain in search of the abscess but it does not provide a satisfactory and efficient drainage for the deeper subcortical brain abscesses again to puncture the dura blindly with a knife through the mastoid opening or any dural exposure is most unsurgical.

*4 Early localized meningitis* Similar to brain abscess formations localized meningitis must frequently result from pre existing otitic and sinus disease cranial fractures are also another common cause. Here again in the early patients in whom lumbar punctures do not reveal the presence of an active organism in the cerebrospinal fluid and therefore indicating that the meningeal infection has not yet become a diffuse process the operation of subtemporal decompression and drainage will offer a definite chance of recovery—although the prognosis is most unfavorable it seems that in only the early

and still localized conditions of meningitis will the operation be of any benefit

The technique of the operation of cranial decompression is described briefly in the accompanying sketches the vertical incision and not the former curved one is most satisfactory

The advantages of this subtemporal decompression are the following

1 It exposes as widely as necessary a comparatively silent area of the brain the temporosphenoidal lobe and therefore any operative damage to the exposed cortex will not appear clinically also in patients having a high intracranial pressure the danger of a hernial protrusion of a highly developed area of the brain with resulting paralysis etc cannot occur

Being situated midway between the frontal and occipital lobes it permits the careful exploration of all parts of the ipsilateral hemisphere ventricular puncture is also possible

2 It exposes the area of the middle meningeal artery so frequently injured in the traumatic cases and also affords excellent drainage to the middle cranial fossa at its lowest point—a very important factor in the treatment of brain injuries

3 A firm closure of the decompression opening is obtained by means of the strong temporal muscle and its overlying fascia with their strong attachment to the parietal crest intact—a most important requisite in patients having a high intracranial pressure hernial protrusions with their frightful fungi are most rare

4 Technically the operation is less difficult than other cranial operations in that the skull opening is made through the thinnest portion of the vault—the squamous portion of the temporal bone

5 The vertical incision is preferable to the former curved one in that it renders more

possible a careful hemostasis of the scalp by means of the method of manual pressure—traction and the clamping of the main branch of the temporal artery at the very beginning of the operation whereas the curved incision passes through the various branches of the vessel in the scalp and they must be clamped individually again the vertical incision not only permits drainage at the lowest point of the skull but it makes possible a large subtemporal bony opening without risk of loosening the attachment of the temporal muscle and fascia to the parietal crest and thus a firm closure with no danger of cerebral hernia is assured

6 The great frequency of temporosphenoidal lesions such as tumors abscesses and brain injuries make this routine exposure of the subtemporal decompression a most important aid in the treatment of underlying subarachnoid lesions

#### CONCLUSIONS

The operation of cranial decompression is one that should be used much more frequently than it is at present especially is this true in the conditions of brain tumor brain abscess brain injuries and in selected cases of spastic paralysis due to an intracranial hemorrhage at birth

The subtemporal method of cranial decompression is the ideal route besides being less difficult technically it exposes an area of the brain most frequently involved This permanent decompression opening does not weaken the skull in that the thick overlying temporal muscle protects it most adequately so that hernial cerebri are not to be feared

The operative mortality is low Patients with intracranial conditions should not be permitted to become blind or to reach the dangerous stage of medullary compression without a subtemporal decompression being performed early

# DEPARTMENT OF TECHNIQUE

## INTERPOSITION OPERATION FOR THE CURE OF PROLAPUS UTERI AND CYSTOCLE

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65 1 h r c H 1 1

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THE excuse for repeating our experience in operating on prolapse and the end result in 68 of them is that practice has fitted us a technique which not only facilitates the operative procedure but secures excellent results and is attended with almost no pain or shock. Our mortality has been nil.

Most cases of prolapse with the usual attendant cystocele, rectocele and relaxation of the pelvic outlet occur in elderly and old women a class of women who demand an operative procedure that is attended with as little danger and shock as possible. Almost all our patients were from the hospital and as soon as possible were able to return to their homes and households just the class that would put any operation for prolapse and cystocele to its everett test.

The interposition operation described by Thomas J. Watkins of Chicago is the foundation on which we have built the drainage which were made from cases No. 85 show in what way our procedure differs.

The following questions were sent to 90 patients and 87 replied. The first was operated on May 31, 1900, and the last May 5, 1918, an average of about ten years. Fifty-nine were operated on at the Carney Hospital.

1. Did the operation relieve you of the trouble of which you complained?

I. The falling down of the part.

3. To what extent has your general health been improved by the operation?

One patient sixty years of age had no return of the prolapse for nearly one year then a ventral hernia appeared there being no return of the cystocele. This also failed and he died two years later. He had return of the prolapse soon after the operation but no return of the cystocele. On his final relief. On death

during childbirth one year after the operation. The doctor did not answer our letter asking for particulars. One has a twenty-two-month-old girl who was the easiest of all her labors, no return of the falling down of the parts. Four were relieved for various periods of time now there is falling down of the parts. One died of cerebral hemorrhage two months after the operation.

From answers received from 68 patients it appears that 54 have been wholly relieved of the troubles complained of at the time of the operation, there has been no falling down of the part and there has been improvement in their general health.

This is certainly gratifying and we know of no other operation for prolapse, uteri and cystocele attended with almost no danger and no shock that give a good end result. It is an operation from which elderly and old people recover quickly.

It was found necessary to repair or amputate the cervix in 55 of the cases and Crookes or Emmet operation for relaxed pelvic outlet and rectocele was done in 6. The oldest patient was sixty-nine, the youngest twenty-one. In one case there was procidentia where pregnancy and childbirth had not been the cause. Forty were between fifty and sixty-nine years of age, while thirty were between forty and fifty.

The five cases in which there was return of the prolapse soon after the operation and the cases in which there was only partial relief were among our first and failure was due to not carrying out in detail the technique which experience showed us necessary.

In every case in which there was a large pelvic outlet Crookes or Emmet operation of a rectocele or Brandler operation should be done.

Pregnancy should not occur after the operation. In most operations for cystocele, not only the vaginal mucosa is removed and a return of the

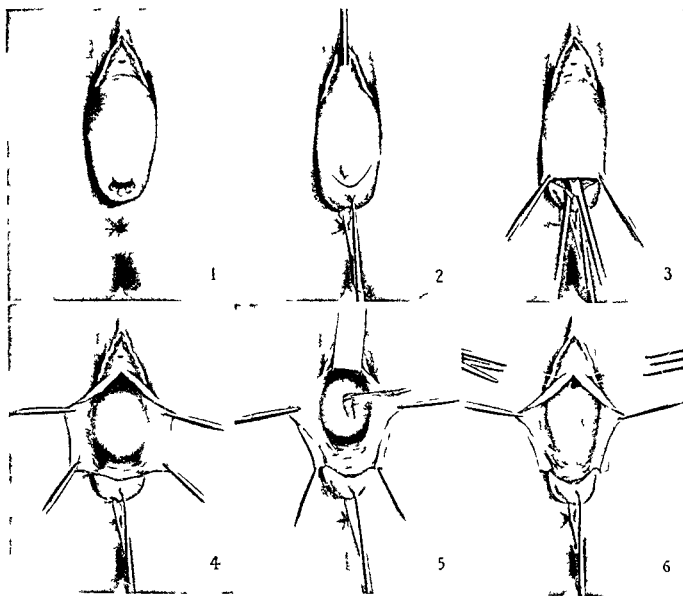


Fig. 1. Case No. 3. Male, aged 60. The bladder is protruding from the vagina. Fig. 2. Same as Fig. 1. The bladder is protruding from the vagina. Fig. 3. The bladder is protruding from the vagina. Fig. 4. The bladder is protruding from the vagina. Fig. 5. The bladder is protruding from the vagina. Fig. 6. The bladder is protruding from the vagina.

Fig. 4. Bladder freed entirely of fascia from fundus to neck.

Fig. 5. Peritoneum has been opened and uterus being delivered into vagina.

Fig. 6. The three sutures of silk worm gut passed through vaginal mucosa and carried deeply into anterior surface of the fundus of the uterus. These sutures remain in place one month.

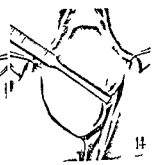
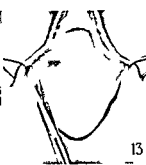
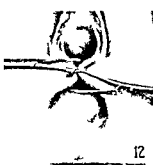
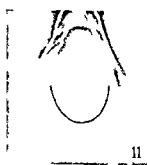
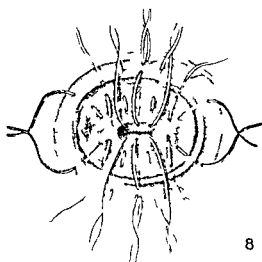
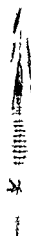
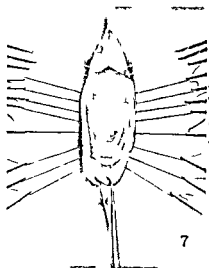
cystocele is almost certain to take place. It is only by separating the fascia completely from the bladder removing what is necessary of it with the vaginal mucosa to get rid of the cystocele and then fasten the fascia and mucosa to the whole extent of the anterior surface of the uterus down to the cervix that one can secure a permanent interposition of the uterus and an obliteration of the cystocele so that it will not return.

It is very difficult at the best to remove the fascia from the bladder in trip with color and

in some cases it is impossible. If the anterior vaginal wall fascia and mucosa is separated from the bladder first by curved pointed scissors (Fig. 3) and then by blunt gauze dissection no fascia will be left on the bladder. The fascia with its overlying vaginal mucosa will be an entity and can be used to the greatest advantage.

It is necessary to cut through the fascia in the median line down to cervical tissue at the base of the bladder keeping it off from side to side until the whole base of the bladder is free. The





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 pel fl Th l p f t pl t d by th h y ll b t tl th t m t f th t l d  
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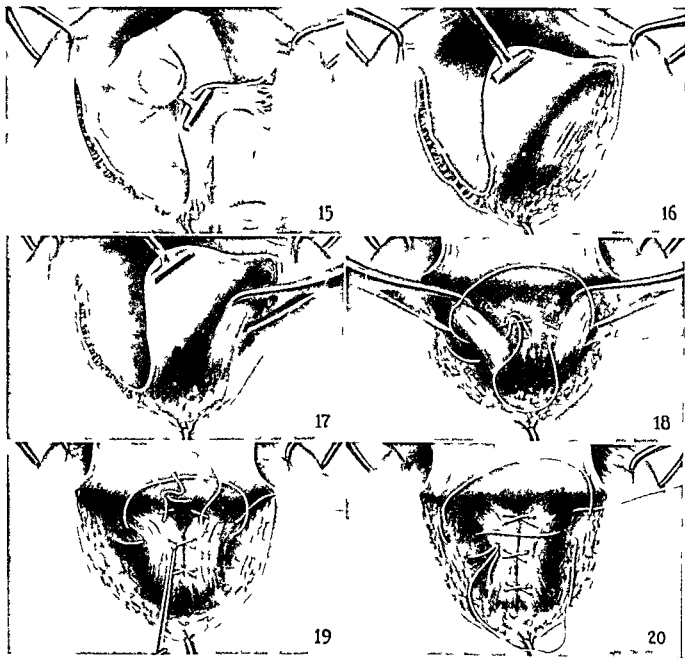


Fig 15 Kill off the underlying tissues from the vaginal wall with the gauze-covered finger. The motion is that of a hand and a roll combined and made against the left index finger which furnishes the counter pressure. The fingers are held snugly for better approximation and approximation of the tissues. They are of course held in the work.

Figs 16-18 The flap has been turned back on the left side showing the pelvic sling positioned in the depth of the wound.

Fig 19 The sling caught with forceps and brought out for better identification and more accurate position of the sutures.

Fig 18 Sling brought into position on each side and the first approximation suture passed. It is held to make it round with the suture before tying.

Figs 19-20 First suture tied and left loop as a tractor. Second suture passed and tied (below first) and third suture being introduced.

Fig 20 All the sling approximation sutures tied. The first suture passed through the mesopelvic tissues.

bladder is freed by gauze dissection from the fascia on the side and toward the urethra as far as necessary to take in the slack of the anterior wall leaving enough to prevent too great traction when the sutures are tied.

When this is thoroughly done the bladder will slide off very easily from the anterior surface of the uterus before the index finger.

Freeing the bladder in this way allows it to be easily pushed up and consequently it is not





Figs. 1 and 2. Fracture of the patella before and after the insertion of an iliac bone graft. Figure 1 shows the separation of the fragment and the tilting forward of the proximal surfaces. In Figure 2 the approximation of the fragments and coaction of the forward tilting are readily appreciable. While the outlines of the iliac graft and the projections of osteogenesis are well shown. The roentgenogram shown in Figure 2 was taken 8 weeks after implantation of the graft.



Figs. 3 and 4. Fracture of the olecranon before and after operation. Figure 3 illustrates the separation of fragments due to action of the triceps muscle while Figure 4 shows the close approximation of the fragments secured by the iliac bone graft and the rapid osteogenesis which is taken place.

in an effort to prevent falling. With the knee bent at an angle of 60° to 90° and the ligamentum patellæ taut and drawn tightly against the femoral condyles, the pull of the quadriceps, the largest muscle in the body, is suddenly exerted with full force at its insertion on the top of the patella, fracturing the latter and tearing the lateral expansions of the quadriceps tendon. The degree of separation of the fragments varies. There is always considerable and there may be extreme separation, the upper fragment sometimes being drawn up to the middle of the thigh.

The line of fracture is regular and almost exactly transverse. After the accident, tags of torn periosteum and fascia fall in between the fragments and become quickly adherent. The fragments are often rotated forward or backward on their transverse axes. Long standing cases have an elongated fibrous band connecting the fragments.

Although the patient can walk, he does so with difficulty, winging the leg forward and locking it in hyperextension before putting his weight upon it, but in some cases pain prevents the patient from walking and also from lifting the foot when lying down.

The diagnosis of transverse fracture is evident at a glance upon inspection of the roentgenogram. Clinical diagnostic features are (1) inability to extend the knee to raise the foot from the bed while recumbent and voluntarily to strengthen

the flexed knee (b) rounded swelling of the knee the result of effusion (c) palpation of the fragments the interval between them and their mobility.

This fracture occasionally requires differentiation from rupture of the quadriceps and from rupture of the ligamentum patellæ or tearing out of its insertion, viz:

1. *Quadriceps rupture.* The patella can be moved downward *in toto* leaving a palpable gap above it at the site of rupture.

2. *Rupture of the ligamentum patellæ or dislocation of its insertion.* The patella can be moved upward *in toto* leaving a gap below it at which point the signs and symptoms are localized.

*Treatment.* Autogenous bone graft for ununited transverse fracture of the patella. The usual treatment for fracture of the patella consists of exposing the line of fracture and uniting the fragment with either an absorbable or nonabsorbable suture. Formerly metal wire such as silver



F                      I g o                      F h

I    e    n l    F    t    f th    I a t l    b e f    d    f t    t    n    b    l    l    y  
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t h    k    f t    n    l    f    t h    t    l    t    t h    p    t l l    f    g n    t    b u    d    t    t    g  
i    k    h l    h l    b h    l    t    d l    t

or phosporbronze wire was used but recently the universal pendulum has been swin in away from non-alloyable material and kangaroo tendon has been largely used. The metal wire formerly used is a rule either placed in a drill hole in each fragment or in such a way as to encircle the patella.

The degree of separation of the fragment in the fracture depends largely upon the amount of laceration of the capsule and connective tissue on either side of the patella. Muscle pull may interfere with the union of the patellar fragment however careful the lacerations and fibrous material are cleaned from between them or whatever may be the material used to hold the fragments in close apposition. Not infrequently a refracture occurs either immediately or remotely after operation in spite of every precaution. Fibrous union with a varying degree of separation of the fragment and a proportional amount of disability in the extremity is a more frequent unfortunate result. To remedy either of these conditions Fogrha suggested that an autogenous bone graft be taken from the crest of the patient's tibia and implanted on the front of the patella to bridge the line of fracture. It is believed that this is an important step and that it offers a trustworthy means of relieving this condition. It would seem however that Rogers technique can be much improved by using the author's inlay method which he has not only applied to relieve fibrous union and refracture but which he offers as a means of securing immediate and solid bony union in certain fresh fractures of the patella (see Figures 12 and 5

to 19). In other words the inlay graft is a reliable preventive of fibrous union and refracture as well as a remedy for those conditions when they already exist and it obviates the employment of a foreign body. Bedecks afford a slight and imperfect contact a graft placed on the anterior surface of the patellar fragments is likely on account of its superficial location to produce pressure necrosis of the soft overlying tissue.

*Technique.*—In all bone graft operations on the extremities a tourniquet is applied to the upper portion of the thigh. The fracture fragments are approached by a U shaped flap the apex of whose convexity lies over the ligamentum patellae its base over the femoral condyle or by the incision shown in Figure 8. All fibrous tissue between the fragments is carefully removed in the case of refracture or fibrous union the fragments are freed (Fig 9). The fragment are approximated and the lateral rents in the fibrous capsule are repaired at the sides with interrupted suture of medium kangaroo tendon (Fig 10). The central portion of the anterior surface of the patella is then denuded of its periosteum and periosteal tissues by turning back laterally flaps of the structure on each fragment (Fig 11).

An outline of the bone to be removed about one and one fourth by three fourths of an inch is made on the anterior surface of the patella with the point of a scalpel. With the small motor saw cuts are made to a depth of one third of an inch along the outline already made (Fig 13). The fracture surfaces of the patellar fragments are tilted forward and with the small motor saw and a



Fig 8

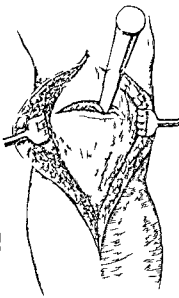


Fig 9

Fig 8 Semilunar and vertical skin incision used by the writer in exposing the patella for the repair of an ununited fracture

Fig 9 Removing the fibrous tissue from between the patellar fragments by means of a sharp thin osteotome

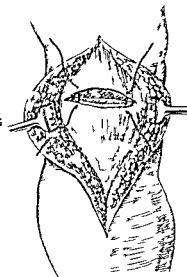


Fig 10

Fig 10 Lateral rents in the fibrous capsule are partially sutured at the sides with interrupted sutures of small kangaroo tendon

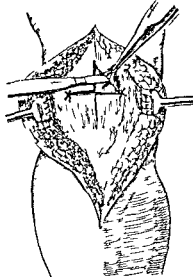


Fig 11

Fig 11 Central portion of anterior surface of patella is being denuded of its periosteum and periosteal tissue by turning back to each side flap on each fragment

narrow thin sharp osteotome the bone within the previously made saw cuts is removed to a depth of one third of an inch from the anterior patellar surface (Fig 14)

With the patellar fragments in good apposition careful measurements are made of the inlay gutter with calipers. The antero internal surface of the upper portion of the tibia where the surface is broad and the cortex thin is exposed and by means of the caliper measurements or a wax model of the gutter in the patella the outline of the inlay graft required is made in the periosteum (Figs 16 and 17). The cortex in this portion of the tibia is of the proper thickness for the graft. The inlay is inserted with its periosteal surface anterior and the periosteal flaps of the patella are pulled over it with interrupted chromic catgut sutures. The rents in the capsule are then sutured with kangaroo tendon as far as the sides of the patella (Fig 19). To insure greater fixation the fragments are securely held by a figure of eight suture of medium size kangaroo tendon passed laterally to the anterior portion of the ligamentum patellæ and quadriceps tendon directly above and below the fractured bone crossing in front of the transplant. The skin incision is closed by a continuous suture of No 1 plain catgut. The limb is immobilized in a plaster of Paris splint for four weeks.

This operation is of the greatest advantage where there has been a fibrous union in an old case and a separation of the fragments coincident with a shortening of the quadriceps tendon and muscle and when the fragments cannot be brought into close apposition this space can be spanned by a long graft which as the result of hypertrophy will entirely or to a large degree fill in the hiatus between the fragments. It is advisable to stimulate osteogenesis by placing fragmented grafts about the inlay.

*Vertical irregular or comminuted fracture of the patella.* This type is due to direct trauma usually a fall. There is little if any separation of the fragments. The lines of fracture are irregular and may be ragged. There is no interposition of soft tissue between the fragments. The fracture is frequently compound.



Fig A type of the inlay graft used by the writer for the repair of fractures of the patella

SOME TECHNICAL POINTS IN GASTRO-ENTEROSTOMY AND GASTROPLICATION<sup>1</sup>

By A SCHWYZER M D F A C S St PAUL MINNESOTA

THE technique of gastro enterostomy has been established for such a long time and has been so copiously discussed and illustrated that I hesitate to present a few minor points which may have been part of the technique of any others. Nevertheless they seem of sufficient interest to be discussed in brief. They apply to the side to side methods. The Y shaped gastro enterostomy is not considered in this paper. The bugbear of gastro enterostomy has been for long time the vicious circle and it has never quite disappeared. No doubt atony of the stomach walls is an important factor in its formation. The surgeon therefore has to do everything possible to secure an easy outlet from the stomach and to avoid the creation of any difficulty of passage. The manner of attaching the gut, whether this be in the iso- or the anti peristaltic sense, has produced much discussion. The easy cutting away of the efferent loop has always been one factor considered though this is perhaps of less importance than what happens to the efferent loop. Nevertheless it must be admitted that in case the efferent loop should become distended even in a moderate way by postoperative adhesions a kink may be disastrous. While a distended intestinal loop even if linked may easily give on its contents the difficulty at the site of gastro enterostomy lies in the circumstance that the peristaltic wave of the gut when it reaches the gastro enterostomy opening loses much or most of its chymus in case the stomach is greatly relaxed. The *vis a tergo* thus is lacking. Under these conditions it is possible that even comparatively slight obstacles become serious to peristaltic attachment of the jejunum may give better results to many operators because by this procedure the inlet is kinked off a beneficial feature in itself. If the pylorus is patent food will pass through even after gastro-enterostomy and will appear in the afferent loop. The afferent opening will therefore not have the same tendency to contract and remain contracted as the distal jejunum which in case of atony of the stomach is not easily offered food. Now as soon as there is no outlet from the lower opening the duodenum and the jejunum above the gastro enterostomy will become distended. In vicious circle the efferent loop becomes so ballooned that the ef-

ferent opening is compressed and pushed out of the way. To guard against all this we should bear in mind the picture of this fully established vicious circle. We therefore have to see that the afferent opening cannot become too large because by enlarging it annexes that originally neutral territory the portion of gut which lies between the two ends of the gastro enterostomy incision. It annexes it for the formation of a wide funnel and the lower jejunal opening is then pushed to the wall and more or less shut by a spur. Besides the guarding against a too wide upper opening we must remember that the upper loop can become very large and bulging. Even if the upper opening is reduced in size the distended loop above it though very short could become so large that it might compress the outlet. For this reason we do well to fix the afferent gut for some distance on the stomach. For the efferent gut it is desirable that it lead rather freely away from the stomach and that its opening be somewhat funnel shaped. To accomplish this in posterior gastro enterostomy we have for years used the following simple means (First and 2)

First The stomach is drawn through the slit in the mesocolon as far as is feasible.

Second The edge of the mesocolon is fastened to the stomach as far on the periphery as possible. In front the mesocolon is often really fastened to the anterior wall of the stomach by grasping the stomach wall through the omental attachment where it can be had between vessels.

Third The gastro enterostomy is made large enough to allow the tips of the four fingers in it.

Fourth The loop is attached in the isoperistaltic sense and the stomach extends from a point about halfway between the greater and lesser curvatures on the afferent (left) side to close to the greater curvature on the efferent end. Thus after the stomach is replaced the gastro enterostomy opening has a downward course on the posterior wall of the stomach and is as much a postero inferior outlet as can well be procured.

Fifth After the posterior Lembert suture is placed the gut incised down to the submucosa the second suture applied and the mucosa opened we then make it a point to grab with the third suture a broad edge of mucosa. It never appealed to me to excise the mucosa. What protect the tissues against secondary ulcer on the suture line

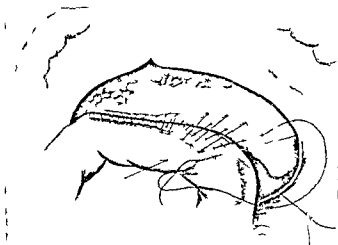


Fig. 1

is the mucosa and for this reason we prefer to secure a bulky covering by pulling ample mucosa over the wound. For the same reason that we are principally concerned to secure a tight covering with mucosa we do not lay great stress on carefully inverting the mucosa when the anterior half of this suture is placed. If the edges are somewhat everted the suture does not look as neat but seen from inside there is no exposed submucosa. The middle suture buries this eversion and the sewing goes more quickly.

Sixth. The anterior Lembert suture is placed in such a manner that after the distal half is finished in the ordinary way it not only pulls the jejunum on the proximal half over to the left and upward by a slanting direction of the suture (see Fig. 1) but the suture in its progress toward the left angle gradually includes broader peritoneal surfaces and thus pulls the gut over onto the stomach. This creates a narrowing and a kinking of the afferent gut and at the same time brings about a broader agglutination at the point where the most pulling is to be expected. The lower jejunal opening is drawn into a more favorable position and its lumen is held open and free from obstructing folds while the upper opening is rendered rather inaccessible from the gastroenterostomy side. This point I have demonstrated many times and it appears to be of value. The sketch shows the suture in a somewhat exaggerated way to emphasize its peculiarity. In reality it is usually preferable not to grasp quite as much surface and to increase the effect to the desired degree by a few additional interrupted sutures. The kinking and therefore comparative inaccessibility for food of the afferent loop is probably as mentioned before a beneficial feature in the antiperistaltic attachment method and this principle under-



Fig. 2

lying in Polya's attachment of the gut after resection of the stomach. We make use of this same principle whenever an anterior gastroenterostomy has to be performed and the necessity of making an enteroanastomosis in this procedure is thus avoided.

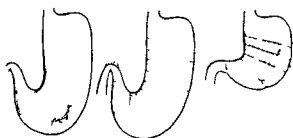
In ulcers of the lesser curvature excision is advised by leading authorities. Rutherford Morrison however among others had good results with gastroenterostomy alone. End result in query in our very small material yielded the following results. Of ulcers of the lesser curvature distinctly away from the pyloric area there were in our material ten cases. In two a resection of the stomach including the pylorus was performed both report themselves as well (after 3½ and 2 years). Another case after good operative recovery could not be traced. One case operated upon 1½ years ago is greatly improved. The remaining six cases were entirely relieved by the operation.

In these cases the aim was to make the opening in the stomach away from the pyloric grinding mill but still at the bottom of the stomach. Furthermore we were anxious not only to make the outlet extra large but to pull enough stomach through the mesocolon to have it pouch. If a rapid and free emptying is particularly desired an elliptical excision of the edge of the gastric muscularis not necessarily including the mucosa may be of assistance.

#### GASTROPLICATION

Atony of the stomach with a sagging downward and a dilatation of this viscus is a condition which is found in patients who usually have suffered for a long time from stomach symptoms due principally to retention and from a reduced nutrition





F 3

Time does not permit dwelling upon the different methods of treatment in these cases with their mostly unsatisfactory results. Suffice it to add that though the surgeon withholds operation as long as he can he may be driven by the severity of the symptoms and the prolonged misery of these patients to try operative relief. Bircher as the first one offered a resection of the stomach which produces horizontal folds through which the greater curvature is raised and its distance from the lesser reduced. Now on examination these stomachs for the most part show that even the lesser curvature has greatly sagged down and the whole organ is like a long bag hung up only on the two ends i. e. the cardiac and the pyloric area. On the pyloric side the attachment is not to the pylorus proper so much as to the first portion of the duodenum where the fixation occurs by the gastroduodenal artery, the bile ducts and the extraperitoneal attachment to the pancreas. A kink in the uppermost portion of the duodenum is the consequence. The kink in its turn causes a more or less marked retention with a gradual dilatation as a further result.

Gastroplication as advised by Bircher creates longitudinal folds in the stomach. The whole organ assumes the shape of a long sausage. The sagging of the lesser curvature is not changed and the acute angle at the outlet is not improved. However if the folds are made in a transverse direction the stomach is very much shortened by them. The degree of shortening can indeed be chosen by the operator. He can make as many transverse folds as seems necessary. Through this the stomach is lifted toward the

cardia and the lesser curvature is shortened and stretched. The kink at the duodenum is effectively counteracted.

In general one is very reluctant to credit any operation of this type with much merit and let me add that I myself am not enthusiastic about such methods. Nevertheless one is at times confronted with a case in which the ptosis is so severe that some corrective measure perhaps in addition to a drainage operation appears desirable. Even admitting that the stomach probably undoes our folding after a while and conceding that improvement after these operations when done in conjunction with a drainage operation is principally to be attributed to the latter, our experience leads us to believe that there is some merit in the procedure. The posterior wall was left untouched in our cases. It could of course be reached to some extent through an opening in the gastrocolic ligament but it seemed too much surgery in view of the moderate promise of such a surgical interference.

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I simply give these data for what they are worth. The indication for such a procedure are surely very limited and rather rare but as long as plication is still done now and then in case of an extreme condition it seemed permissible to bring this modification to your attention because it corrects or helps to correct the kink at the outlet of the stomach.

A SUMMARY OF THE SURGICAL TREATMENT OF GOITER<sup>1</sup>

By MILFS F. PORTER, M.D., F.A.C.S., Ft. WAYNE, INDIANA

GENERALLY speaking surgical services are sought by goiter patients because of (1) toxic symptoms (2) pressure symptoms (3) deformity and (4) a combination of these difficulties.

When patients with symptomless goiters seek the services of the surgeon for fear their benign goiters may become troublesome and not until then will there be achieved all that is possible in the relief and cure of this disease.

I should like to repeat here what I have said in effect several times before, namely, that the wisdom of removing simple goiters for fear of their becoming toxic is quite as evident as is the wisdom of removing warts, moles, scars, etc. for fear of their becoming malignant. Subtotal thyroidectomy is the operation of choice in all patients who are good surgical risks. Safety first is the slogan here as universally elsewhere and therefore the incision should be ample and located with a view to an adequate exposure of the gland. Whether or not the muscles should be divided on one or both sides depends upon the individual case. The rule should be to divide the muscles when necessary to secure adequate exposure of the operative field. When divided the section should be made as near the upper attachment as possible. It is preferable to grasp all the tissues including the superficial fascia and muscles on the side or sides to be divided with two forceps and make the incision between. Properly placed sutures will coapt all structures divided and effectually prevent hemorrhage.

For circumscribed hypertrophy, cysts or adenomata the incision may with safety be made relatively small, provided it be properly located. There is no orthodox incision for goiter.

In cases of general hypertrophy, wherein subtotal removal is contemplated, a full exposure of the gland should be secured not only for the sake of safety, but for the further purpose of enabling one to judge more accurately of the characters presented by the different parts of the gland. In a previous paper<sup>2</sup> I called attention to the fact that the hyperactive portions of the gland could usually be distinguished from the normal or inactive portions. It is generally believed I think that the hyperactive gland structure is usually red, rather firm and somewhat

resembles beef steak. On the contrary, it has been my observation in quite a number of cases that the hyperactive trouble-producing portion of the gland as indicated by the microscopic picture present is often if not usually lighter in color and softer than the normal gland structure. Further observations made since those upon which the statements made in the paper above referred to were based confirm the conclusions reached therein.

With the style of dress commonly worn by women today it is quite impossible to locate the incision so that the scar will be covered. It follows therefore that the scar should be as inconspicuous as possible. To achieve this end the incision should be made to follow the natural folds of the skin; the skin should be cut through at right angles to the surface and the skin wound should be closed with subcuticular sutures with the aid of adhesive plaster if necessary to perfect the coaptation. A stitch scar in a place where it attracts attention is a surgical sin. No other method of wound closure with which I am acquainted gives as good medical results as the one here recommended.

Lobectomy is frequently an unsatisfactory operation in that it leaves the neck asymmetrical and often fails to give adequate relief.

The portions of the gland structures to be left after thyroidectomy should be selected in so far as is possible with a view of avoiding future asymmetry. One should leave not any more gland structure than would amount to one-fifth the normal — the aim should be to leave normal gland tissue. Non-functioning gland tissue is useless and hyperplastic tissue if left will keep up the symptoms of intoxication for a longer or shorter time and sooner or later degenerate and become useless. That it will not always be possible to select normal tissue to leave I am of course well aware, but I am convinced that efforts made along this line are well worth while.

It is perhaps better always to divide the isthmus completely when it can be done without additional risk. This procedure is advised with a view to the relief or prevention of the pressure symptoms. Preservation of the posterior capsule will effectually protect the parathyroids and recurrent laryngeal nerves. Drainage adds both to the safety and comfort of the patient and it is therefore seldom wise to omit it. Strips of rubber dam make the

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best drainage material. Drains should be removed as soon as the discharge becomes negligible usually at the end of 48 or 72 hours after the operation.

Adhesion of the skin to the larynx or trachea is not an infrequent cause of annoyance. This can be avoided by securing the interposition of a layer of cellular tissue between these structures.

Generally speaking ether anaesthesia is the safest and most satisfactory. To this rule there are of course exceptions but they are rare. It is generally conceded that when a patient dies from appendicitis it is almost always because someone has blundered. The sooner it is generally conceded that it is a grievous error for a goiter patient to put off consulting the surgeon until the time for safe surgery is past the sooner will the number of goiter deaths be decreased. In the present state of our knowledge concerning goiter there is no excuse for any but a very small proportion of goiter patients first seeking surgical relief after the time for safe surgery is past.

For the preparation of the sub standard risks for the major operation injections of boiling water into the gland substance is more effectual than any other known procedure. In a large percentage of patients with small goiter of the diffuse hyperplastic variety injections of boiling water should be the treatment of choice in that it is efficacious and entails less risk and less loss of time than any other method of treatment equally efficient. This method of treating goiter has already been published.<sup>1</sup> It is now in quite general use and a detailed presentation of the subject is unnecessary.

In closing I should like to urge the especial importance of foci of infection in goiter patients. Not infrequently the removal of these foci will cause the goiter symptoms to disappear. To allow such foci to remain after thyroidectomy is to invite a recrudescence of the goiter symptoms. Besides it should be remembered that thyroidectomized patients are especially vulnerable.

S. G. GY & OBST. 715 S.

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QUINTESSENCE OF MEDICAL CLINICS. A series of concise clinical monographs and lectures. By Frank Smithies, M.D., at St. Augusta, Ill. Chicago: St. Louis Medical and Surgical Publishing Company, Inc. 1914.

INFECCIONE D TIPO GRIPAL. By A. to P. g. nd Luis Lamas. Madrid, 1914.

SURGERY OF THE THORAX AND VISCERA. Symptom Diagnosis and Treatment. By Benjamin M. Ricketts, Ph.D., M.D., LL.D., F.A.C.S., Cincinnati, 1914.

NOTES IN PATHOLOGICAL AND OPERATIVE OBSTETRICS. By Lily G. McNeil, M.D., Los Angeles. Division of Obstetrics, College of Physicians and Surgeons, Medical Department of the University of California, 1914.

# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE PUBLISHED MONTHLY

VOLUME XXVIII

MAY 1919

NUMBER 5

## PANCREATIC LYMPHANGITIS

WITH AND WITHOUT JAUNDICE<sup>1</sup>

BY JOHN B. DWYER, M.D., I.A.C.S., PHILADELPHIA

**D**URING the past decade discussion of the pancreas has been productive of a considerable amount of literature for some of which I have to acknowledge responsibility. The pancreas is so commonly involved in operation for upper abdominal conditions that I have thought it worth while again to direct attention to it and to consider the relation between the pancreatic lymph glands and other abdominal viscera.

The gall bladder, bile ducts, pyloric region of the intestines and the second part of the duodenum through their efferent lymph channels are placed in intimate relation to the head of the pancreas and it is the head of the pancreas that is most frequently involved in pancreatitis associated with other upper abdominal diseases. The course of infection has time and again been observed at the operating table in gall bladder diseases. Inflammation of the gall bladder is followed by enlargement of the cystic lymph glands, periductal lymphangitis, enlargement of the glands at the head and at the margin of the pancreas and often of the regional lymph channels at the head of the pancreas.

The lymph drainage from the head of the pancreas passes through the lymph glands of the common and hepatic ducts. A cholecystitis causing great enlargement of the glands can produce pressure and jaundice or a lymphædema or a lymph borne infection of the

head of the pancreas just as at times lymphædema is seen in the arm following amputation of the breast and removal of the axillary glands. The gland group in both instances drains three regions.

Induration of the head of the pancreas about the common duct is present in 35 to 40 per cent of diseases of the gall bladder not only in cases with common duct stone but also in many cases where the gall bladder is only slightly diseased but in which there is enlargement of the lymph glands draining the gall bladder and also in a number of cases of strawberry gall bladder with or without stones.

In the course of my abdominal work I am becoming more and more convinced that the first stage of chronic pancreatitis is nearly always disease of the pancreatic lymph glands. This primary disorder can rarely if ever be diagnosed before operation nor is a pre-operative diagnosis of chronic pancreatitis always possible. In both conditions the predominant symptoms are those of some upper abdominal disease with which they are more often than not associated principally gall bladder disease, peptic ulcer disease of the liver or appendicitis. In the absence of definite indications of calculi the appearance of jaundice serves to suggest the possible cause of the trouble. The onset of jaundice in these cases as a rule is gradual and its

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intensity variable at first is apt to be more constant than when due to stone or stones in the common duct. The difficulties of diagnosis are illustrated by the following case recently operated upon by me at the Hospital of the University of Pennsylvania:

The patient male aged 8 years, a healthy, well-nourished child, with a history of jaundice for the last 12 months. The jaundice began four years ago, and was at first accompanied by fever and chills. The child was then treated with quinine and other remedies, but the jaundice continued. The child was then treated with cod liver oil and other remedies, but the jaundice continued. The child was then treated with cod liver oil and other remedies, but the jaundice continued.

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E. A. Graham has recently demonstrated that enlargement of the liver is a feature in 87

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per cent of cases with disease of the biliary tract. A rather too large percentage I am inclined to think. Nevertheless he finds that this enlargement occurs regardless of whether or not calculi are present or whether or not there is obstruction of the cystic duct and states that if cholecystitis is well established it is very probable that ascending infection of the liver may constantly recur possibly through the lymphatics surrounding the bile passages. We all know that a gall bladder once infected rarely regains its normal condition. It will have a tendency to harbor bacteria which in turn may lead to infection of the liver through the lymph channel around the biliary tract.

The following case recently operated upon by me at the Lankenau Hospital well shows pancreatic lymphangitis as the precursor of a pancreatitis which was without doubt obviated by operation.

The patient male, 42 years of age, a healthy, well-nourished man, with a history of jaundice for the last 12 months. The jaundice began four years ago, and was at first accompanied by fever and chills. The patient was then treated with quinine and other remedies, but the jaundice continued. The patient was then treated with cod liver oil and other remedies, but the jaundice continued.

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These pancreatic and peripancreatic inflammations as I have elsewhere pointed out are comparable to cervical adenitis following

tonsillitis or inguinal adenitis after an infection of the extremity. The subsidence of the infection in the gall bladder is steadily followed by subsidence of the lymphangitis. In view of the fact that in the present state of surgery we have no successful means of directly attacking the chronically diseased pancreas it is obvious that early treatment of this prepancreatitis if I may coin the term is most desirable. Medical treatment is slow not always successful and offers no assurance of freedom from recurrence. Surgery gives reasonable assurance of removing all foci of infection and consequent freedom of recurrence.

Disease of the prepancreatic lymph gland without jaundice is demonstrated in the following instance:

Male, age 30, admitted to the Lankenau Hospital complaining of upper abdominal distress after eating. The history shows seven years of periodic attacks of epigastric pain four to six hours after meals relieved by alkali. No nocturnal pain relieved by food. There is no constipation, no history of jaundice nor of gall stone colic, no nausea or vomiting. Physical examination is negative except for the abdomen. The abdominal wall is relaxed, peristalsis active. The stomach capacity is 2,000 cubic centimeters. We were unable to wash out the stomach entirely. The stomach is slightly ptosed.

X-ray confirmed gastropnoia and demonstrated pyloric obstruction. Diagnosis, duodenal ulcer. At operation adhesions running across the duodenum to the gall bladder causing partial obstruction were released. There were enlarged glands along the neck of the gall bladder and along the common duct. A spastic hourglass contraction of the duodenum relaxed under manipulation.

The prepancreatic lymph glands were enlarged and hard. The head of the pancreas was large and hard. Some perisplenic adhesions were released. A large chronic indurated ulcer was present at the junction of the pylorus and duodenum, the incision extending down into the duodenum and upward along the lesser curvature of the stomach. An anterior gastrotomy brought to view a large bleeding ulcer one inch in diameter. Considerable blood was found in the stomach. The opening in the stomach was closed with chromic gut and linen. Posterior gastroenterostomy was done. A chronically diseased gall bladder was removed. The cystic and common ducts were found to be patulous. A fibrous appendix was removed. This patient made an uneventful recovery and has been entirely relieved of his symptoms.

Without enlarging upon the pathology and the surgical details of the question I have cited these cases in order to emphasize the importance of early surgical treatment of upper abdominal disease before a possible pancreatitis has time to get in its destructive work.

intensity variable at first, apt to be more constant than when duct infection is in the common duct. The difficult diagnosis is illustrated by the following case recently operated upon by me at the Hospital of the University of Pennsylvania:

The patient, a male, 35 years of age, had been ill for several months with a fever, chills, and a pain in the right upper quadrant. He had been treated by the following case recently operated upon by me at the Hospital of the University of Pennsylvania:

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The following case recently operated upon by me at theankenau Hospital well shows pancreatic lymphangitis as the precursor of a pancreatitis which was without doubt obviated by operation.

The patient, a married, 45 years of age, had been ill for several months with a fever, chills, and a pain in the right upper quadrant. He had been treated by the following case recently operated upon by me at the Hospital of the University of Pennsylvania:

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Disease of the prepancreatic lymph glands without jaundice is demonstrated in the following instance:

Male, age 39, admitted to the Lankenau Hospital complaining of upper abdominal distress after eating. The history shows seven years of periodic attacks of epigastric pain four to six hours after meals, relieved by alkalis. Also nocturnal pain relieved by food. There is no constipation, no history of jaundice nor of gall stone colic, no nausea or vomiting. Physical examination: negative except for the abdomen. The abdominal wall is relaxed, peristalsis active. The stomach capacity is 600 cubic centimeters. We were unable to wash out the stomach entirely. The stomach is slightly ptosed

slightly confirmed gastropnoia and demonstrated pyloric obstruction. Diagnosis: duodenal ulcer. At operation adhesions running across the duodenum to the gall bladder causing partial obstruction were released. There were enlarged glands along the neck of the gall bladder and along the common duct. A spastic hourglass contraction of the duodenum relieved under manipulation.

The peripancreatic lymph glands were enlarged and hard. The head of the pancreas was large and hard. Some perisplenic adhesions were released. A large chronic indurated ulcer was present at the junction of the pylorus and duodenum, the incision extending down into the duodenum and upward along the lesser curvature of the stomach. An anterior gastrotomy brought to view a large bleeding ulcer, one inch in diameter. Considerable blood was found in the stomach. The opening in the stomach was closed with chromic gut and linen. Posterior gastroenterostomy was done. A chronically diseased gall bladder was removed. The cystic and common ducts were found to be patulous. A fibrous appendix was removed. This patient made an uneventful recovery and has been entirely relieved of his symptoms.

Without enlarging upon the pathology and the surgical details of the question I have cited these cases in order to emphasize the importance of early surgical treatment of upper abdominal disease before a possible prepancreatitis has time to get in its destructive work.



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The patient, male, aged 54, was a high school graduate, and had been in the United States Army for 12 years. He had been in the United States Army for 12 years. He had been in the United States Army for 12 years.

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L. A. Crum has recently demonstrated that enlargement of the liver is a feature in 87

percent of tract and is inclined to the enlargement or not calculi there is obstruction. It is a common infection of the possibly through the bile passage gall bladder once normal condition to harbor bacteria infection of the channel around the

The following case by me at the J. H. P. Pancreatic lymphangitis, pancreatitis which was treated by operation.

The patient, male, aged 54, was a high school graduate, and had been in the United States Army for 12 years. He had been in the United States Army for 12 years. He had been in the United States Army for 12 years.

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These pancreatic and peripancreatic inflammation and wherever pointed out are comparable to cervical adenitis following

tonsillitis or inguinal adenitis after an infection of the extremity. The subsidence of the infection in the gall bladder is steadily followed by subsidence of the lymphangitis. In view of the fact that in the present state of surgery we have no successful means of directly attacking the chronically diseased pancreas it is obvious that early treatment of this prepancreatitis if I may coin the term is most desirable. Medical treatment is slow, not always successful and offers no assurance of freedom from recurrence. Surgery gives reasonable assurance of removing all foci of infection and consequent freedom of recurrence.

Disease of the prepancreatic lymph glands without jaundice is demonstrated in the following instance.

Male age 39 admitted to the Linkenau Hospital complaining of upper abdominal distress after eating. The history shows seven years of periodic attacks of epigastric pain four to six hours after meals relieved by alkalis. Also nocturnal pain relieved by food. There is no constipation, no history of jaundice nor of gall stone colic, no nausea or vomiting. Physical examination: negative except for the abdomen. The abdominal wall relaxed peristalsis active. The stomach capacity: 2700 cubic centimeters. We were unable to wash out the stomach entirely. The stomach is slightly ptosed.

X-ray confirmed gastropnoia and demonstrated pyloric obstruction. Diagnosis duodenal ulcer. At operation adhesions running across the duodenum to the gall bladder causing partial obstruction were released. There were enlarged glands along the neck of the gall bladder and along the common duct. A spastic hourglass contraction of the duodenum relaxed under manipulation.

The peripancreatic lymph glands were enlarged and hard. The head of the pancreas was large and hard. Some perisplenic adhesions were released. A large chronic indurated ulcer was present at the junction of the pylorus and duodenum the incision extending down into the duodenum and upward along the lesser curvature of the stomach. An anterior gastrostomy brought to view a large bleeding ulcer one inch in diameter. Considerable blood was found in the stomach. The opening in the stomach was closed with chromic gut and linen. Posterior gastroenterostomy was done. A chronically diseased gall bladder was removed. The cystic and common ducts were found to be patulous. A fibrous appendix was removed. This patient made an uneventful recovery and has been entirely relieved of his symptoms.

Without enlarging upon the pathology and the surgical details of the question I have cited these cases in order to emphasize the importance of early surgical treatment of upper abdominal disease before a possible pancreatitis has time to get in its destructive work.

## PRACTICAL CONSIDERATIONS WITH REGARD TO PERMANENT COLOSTOMIES

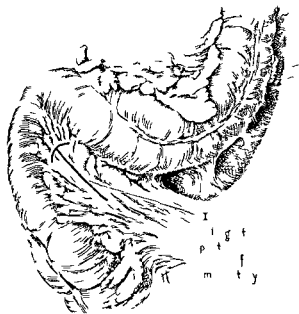
B. W. WISSTRUNK, M.D., F.A.C.S., R. T. M.  
F. m. h. M. I.

EACH year we see a number of patients in whom we find it necessary to make permanent colostomy. As a rule these colostomies are made in certain patients selected from a group of cases in which it has been found necessary to excise the rectum and sphincter muscle for cancer and in cases of inoperable cancer of the rectum. The patient thus operated on have given us an excellent opportunity to test the various types of operation and to note the annoying condition which may arise following a permanent colostomy.

In reviewing briefly the anatomy of the lower colon it will be remembered that the posterior one third of the descending colon from the splenic flexure to the sigmoid usually lies behind the peritoneum. This portion of the bowel has as a rule a very short mesentery and often is more or less fixed

to the posterior abdominal wall. Near the beginning of the sigmoid flexure the peritoneum completely surrounds the bowel and the mesentery supplying this portion becomes much longer usually measuring from three to six inches in length.

Nearly every type of colostomy that has been suggested and that seemed practical has been used in the Mayo Clinic but up to the present time operation or procedures undertaken with an idea of giving the patient control of the bowel passage have almost always proved disappointing. Until recently we made the majority of colostomies through an oblique muscle splitting incision in the left inguinal region. The loop of bowel brought up for the colostomy was supported by a glass rod and rubber tube, a piece of linen or silk worm suture and was cut across five or six days following the operation. Many of the colostomies made in this manner were perfectly satisfactory. In a few of the cases there was a tendency toward the development of a ventral hernia into the tissues surrounding the colostomy. More frequently however the tendency has been toward a retraction of the loop of bowel in which the colostomy was made allowing in some instances the proximal end of the bowel to discharge a part of its content into the distal end. We also have found in instances in which the bowel was cut off at or near the level of the skin that there is a tendency on the part of the skin to contract around the opening in the bowel thus narrowing it sufficiently to interfere with the proper discharge of feces. In looking back on the group of colostomies made in this manner it is easy to explain the reasons for the development of most of the conditions. The incision was made over a portion of the bowel which was more or less fixed and if the sigmoid flexure was pulled up and used as a loop for the colostomy this was often effective

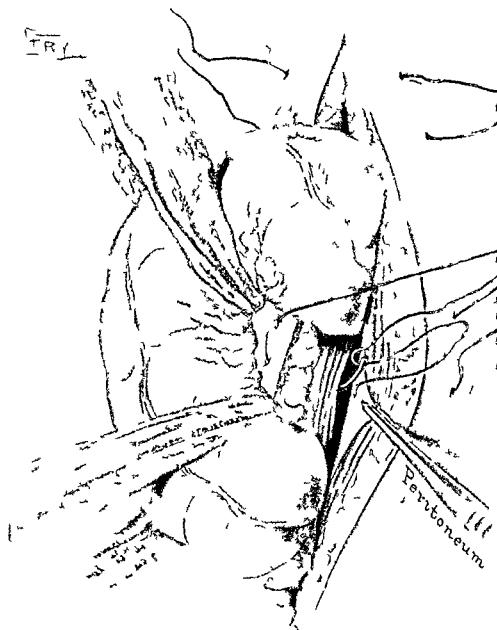


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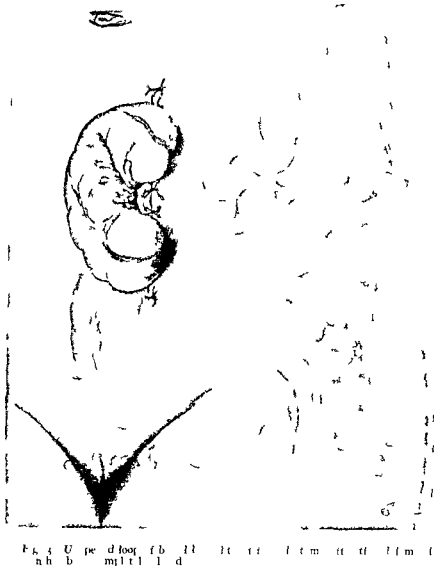
Sutures pass through  
entire thickness of abdominal wall

Fig 2. Fold of the opening of the me enter of the sigmoid being held in place by gauze while a portion of the abdominal wall is being closed through the opening.

acted with considerable difficulty. After the colostomy had been made the edges of the abdominal wall were separated for a distance of from two to three inches by two limbs of bowel and the me enter supplying the loop used for the colostomy. This naturally left a large opening through the abdominal wall which in some instances permitted a hernia

of the loop or allowed the loop to retract or pull inward toward the abdominal cavity.

In many of the operations for excision of the rectum a segment of the sigmoid is left between the colostomy and the site where the bowel is cut off in making the excision of the rectum. In such instances if the co



colostomy retract sufficiently to permit the distal end to empty its contents into the segment the feces gradually accumulate and produce a large painful tumor. Occasionally we have found it necessary either to remove this segment or to empty it and perform a plastic operation which will more widely separate the end of bowel.

We are now making a colostomy very similar in type to the one described by Mixer. As a rule this colostomy is made through a straight incision placed below and about one inch to the left of the umbilicus.

An incision of this type poses a distinct

advantage. Although it is thorough exploration of the abdominal cavity may be made. If it is found necessary a primary resection of the bowel is possible or the first stage of the three stage Mikulicz operation can be done. The incision may be extended in either direction and if after the exploration it is decided to make a colostomy this is made through the center or upper end of the incision.

#### OPERATION

The colostomy is made in a loop of the sigmoid flexure the portion of the bowel is chosen because of its extreme mobility and

the length of its mesentery. After the loop has been lifted out of the abdominal cavity an incision from one and one half to two inches in length is made through its mesentery parallel to the direction of the blood vessels and extending upward nearly to the bowel. A second incision about one inch long is then made across the end of the first incision quite near the mesenteric attachment of the bowel. Two strips of gauze are placed in the upper end of this 1 incision and when these are pulled apart a good sized opening through the mesentery is created. The two sides of the entire abdominal wall near the center of the abdominal incision are sutured through this opening in the mesentery. The remaining portions of the incision are then closed a small bite of the bowel is included in two of the sutures to prevent the possibility of herniation of a loop of small intestine. When the gauze has been removed a glass rod or rubber tube is placed through the opening in the mesentery between the skin and bowel to serve later as a guide in cutting across the bowel (Figs 1 2 3 and 4).

If necessary for gas distention a small opening may be made in the bowel any time after twenty four to forty eight hours and in from five to six days the bowel is cut across completely with the cautery. As a rule however the patients pass gases very readily through the knuckle which has been brought up and it is unnecessary to disturb it before five or six days. After the loop has been cut across it will be found that the two ends of bowel are separated by the entire abdominal wall for a distance of from one to one and one half inches and that the cut ends of bowel protrude for a distance of an inch or

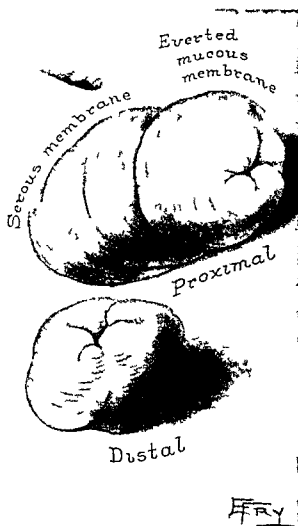


Fig. 4 End of the bowel after it has been completely cut across

two above the skin. These may later be cut shorter if thought necessary.

The advantages of an operation of this type can be readily seen. In our hands it has obviated some of the difficulties which have often followed other types of colostomy.

## THE TREATMENT OF HODGKIN'S DISEASE

B. CLIFFORD BURNHAM, M.D., F.A.C.S., B.

FEW morbid processes present greater variation in rate of progress and more protean clinical manifestation than does Hodgkin's disease. Its course may be ruinous in a few weeks or extend over years. Emaciation may be pronounced and the constitutional disturbance slight but often the exact reverse is true. The primary lesion may appear in the neck, in the mediastinum, in the abdomen or in all the above simultaneously. The patient may come to us for help for pruritus with or without skin rash for a chronic cough or dyspnea for edema of the leg or for an invasive breast growth. Periods of quiescence and rapid progress alternate in many cases; in other there is a steady march of the disease. Without treatment all recorded cases have ended in death. There is no authentic report of a spontaneous cure although it is quite possible that such does occur.

Over a period of six years I have treated more than a hundred cases of Hodgkin's dis-

ease and malignant lymphoma or lymphosarcoma which resemble it so closely clinically. I have in preparation a detailed case and statistical report of this series. I will not, however, describe individual cases in this paper nor give a critical review of the very valuable studies in recent literature although such a review is almost indispensable to an adequate presentation of the progress being made in the knowledge of the etiology, pathology and treatment of the disease. I must confine myself to a few practical conclusions drawn from my own experience.

## DIAGNOSIS

Exact diagnosis is necessary as a preliminary to adequate treatment and such has no secret. On X-ray blood and tissue examinations as well as on a careful general physical examination.

In the advanced stage the examination of the most reliable single criterion. By this



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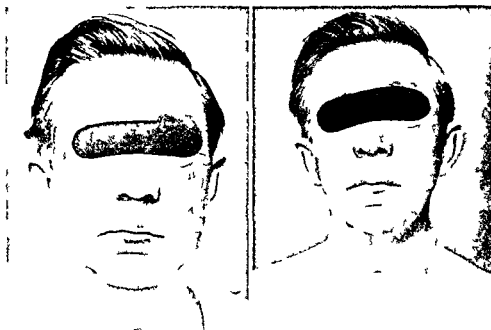


Fig. 3a (at left) Mr. I. C. (309) Hodgkin disease. No tissue. Blood in characteristic. Photograph taken April 6 1916 before treatment.

Fig. 3b Mr. I. C. (309) Photograph taken April 7 1917 after five treatments. No treatment in. At present no evidence of trouble. Well for nearly three years.



Fig. 3a (at left) Mrs. D. I. (290) Chronic Hodgkin disease. The treatment of skin and lavicle and infiltration of breast. Photograph taken February 3 1916 before treatment.

Fig. 3b Mrs. D. I. (290) Photograph taken October 1916 after ten treatments. Still under treatment. At present her arm is greatly enlarged but her general health is good.





Fig 4 (left) M R L (6) Lymph m  
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method the typical Dorothy Keel Hodgkin disease lymphoma tuberculosis syphilis and the metastatic tumor are readily separable. In very early lesions it may be impossible to distinguish between lymphosarcoma Hodgkin disease simple hyperplasia and tuberculosis as they all have more or less the microscopical characteristics of lymphoma.

A routine diagnostic measure I advocate the removal of at least two isolated glands. I have seen no prejudice of disease as a consequence of this procedure. On the contrary attempted removal of large masses as in block dissection of the neck frequently aggravates the disease.

As to whether there is a common etiologic cause of Hodgkin disease and lymphosarcoma I am unprepared to express an opinion but until such relationship is shown to exist I feel that they should be considered as separate diseases.

Blood examinations are relatively much less valuable than tissue examination. A positive finding of Bunting's blood picture does not necessarily mean that the patient has Hodgkin disease nor does a negative finding show the absence of such disease. For out of 4 cases where the tissue showed positive Hodgkin disease the blood was

positive in only 2 instances and was negative in 13. Moreover out of 26 cases where the tissue showed positive lymphosarcoma 3 cases showed the blood which Bunting has designated as characteristic of Hodgkin disease.

X-ray examinations are indispensable in determining mediastinal and chest involvement. They frequently prove the presence of marked trouble when neither the history nor ordinary physical examination suggests it.

#### TREATMENT

The medical treatment of Hodgkin's disease is most unsatisfactory. A few apparent cures are from x-ray and other forms of therapy are on record. My impression is that when therapy is forced it tends usually to make the disease progress more rapidly.

Vaccines made from the diptheroid organism have been extensively used but with indifferent results. I have had no personal experience with them.

Under the influence of the splendid work of Bunting and Yates there has been a marked revival in favor of surgical removal of Hodgkin's gland—a procedure which had been well nigh abandoned because of the impression that it was not only useless but harmful. There can be no question however



Fig. 5a (at left) R. I. (41) Acute Hodgkin's disease. Patient was extremely ill with huge mass on neck, chest and abdomen. There was high fever and marked emaciation. Roentgenogram taken April 7, 1916, showing chest and left retrosternal.

Fig. 5b (at right) R. I. (41) Roentgenogram taken March 15, 1918, shows improved condition 10 years later after a series of radium treatment. General condition at present satisfactory although there is a recurrence of the tumor in the left retrosternal.

that their more satisfactory experiences are due to the invariable and immediate employment of X-ray treatment in conjunction with the operative removals.

X-ray therapy in Hodgkin's disease is not new. It has been widely practiced ever since Nicholas Senn's report now nearly twenty years ago. That the X-ray has a very beneficial effect both in ameliorating constitutional symptoms and in reducing tumor there can be no question. Nevertheless few if any authentic cures by this method are on record.

While many of our patients had been treated both operatively and with X-ray, I have made use only of radium, combining it in some cases with rest in bed, forced feeding and iron in the form of Blaud's pills.

Most of the patients were in advanced stages of the disease. Many of them were acute cases, some of them practically in articulo mortis.

I have excluded from consideration only those cases in which the disease was limited to the tonsil, where it is difficult to classify as Hodgkin's lymphosarcoma or hyperplasia. Most satisfactory results have been obtained in this group, which doubtless contains instances of Hodgkin's disease.

In general I find that better results are obtained in cases where the tissue examina-

tion shows lymphosarcoma than where it shows Hodgkin's disease, and in Hodgkin's disease where the characteristic polymorphonuclear leucocytosis is not present.

Chronic cases are more favorable than acute. Intensive prolonged exposures very satisfactory in some chronic cases are quite unsuitable in acute cases.

In a chronic case limited to one set of glands a single exposure may lead to a cure, which has in one case extended over five years. Heavy exposures in acute Hodgkin's disease are usually followed by rapid reduction in the size of the gland masses but with no corresponding improvement in the blood or the patient's general condition. In these acute cases rest in bed, forced feeding and mild fractional radiation are indicated. This method of treatment we have used for only about one and one half years and are consequently unable to report on the results. Acute cases treated more than one and one half years ago with the heavy dose method are dead with the exception of Miss R. T., aged 18. This girl was admitted to the hospital on April 6, 1916, with high fever, a great mass in the abdomen and another in the chest. She was extremely emaciated and evidently dying. Under treatment there was apparent complete cure lasting for more than



The patient had a history of Hodgkin's disease, which was first diagnosed in 1935. The patient had been treated with radiation therapy and had been in remission for several years. The patient had a history of lymphatic involvement and had been treated with radiation therapy. The patient had a history of lymphatic involvement and had been treated with radiation therapy.

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ne and one half year. There was then an stenosis abdominal recurrence which was at the present time yielding to treatment.

Test and abundant feeding are of great importance in the chronic case. Heavy work and exposure readily lead to relapse.

The most unfortunate chronic cases are those with very little glandular enlargement but with marked constitutional symptom and change in the blood. In two or three cases of this kind met with there has been but little amelioration of the patient's condition following treatment.

In every case where the infection is limited to a single group of gland, such as one side of the neck and axilla, a complete disappearance of the gland can be looked for with confidence. Where the disease extends especially in mediastinal cases, this is more uncertain.

In chronic Hodgkin's disease the disappearance of the gland may be almost invariably accompanied by improvement in general health, gain in weight, disappearance of pruritus and the return of the blood to a normal appearance.

#### TECHNIQUE

Treatment must be so planned that adequate radiation will be applied to all parts of

the body affected by the disease. At the same time great care must be taken to avoid injury of normal structures particularly the skin. It is probably desirable even in early localized cases to irradiate all the regions of the body in which Hodgkin's disease is likely to appear. There is apparently no effect on gland matter when not directly irradiated.

The guide to treatment is to be found in the effect on the gland matter, the blood, the appetite and the general health of the individual case. No fixed plan of treatment is possible as a routine measure. The dose that is effective in causing gland disappearance in one case may be many times greater than that required in another case. One patient may suffer with loss of appetite, fever and general malaise from a treatment which when given another causes none of these disturbances. I should say that several hundred milligram is a workable minimum for use in the treatment of Hodgkin's disease. In a few cases we have used as high as fifty gram hour in a single dose.

Gamma radiation from radium placed at a distance from the surface varying from one and one half to five inches has been used—the length of the exposure being inversely proportional to the amount of radium employed.



Fig 6a Mr C S B ( 55) Hodgkin's disease  
with cervical mediastinal and axillary involvement  
Tissue and blood lymphatic Roentgenogram  
taken February 7 1916 before treatment

Fig 7b Mr C S B ( 55) Roentgenogram taken  
March 6 1917 after three treatments Patient has been  
well for nearly three years

#### GENERAL RESULTS

The reduction of gland masses amelioration of discomforts and improvement in general health already referred to occur in most cases and sometimes are most striking in the very advanced stages. It seems to me that we may confidently look for permanent cure in an increased proportion of these patients with further improvement in our methods of treatment. It is of course impossible to fix any definite time limit as an indication that the disease will not recur. I recently had the experience of an extensive abdominal recurrence and death in a patient apparently well for four years from a pharyngeal and neck lymphosarcoma.

Including all patients where apparent cure has been less than three years we have had where lymphosarcoma was diagnosed 1 case perfectly well and without signs of

trouble for more than five years one an extensive neck cancer and one an abdominal cancer. Four cases have been apparently well for over three years 1 with pharyngeal and neck involvement 1 with mediastinal 1 with tonsil neck and groin and 1 case with neck and axilla involvement.

Including all patients where apparent cure has been less than three years we have had where Hodgkin's disease was diagnosed 1 patient with mediastinal and neck involvement well for four years and 2 cases well for more than three years. One of these had neck axilla groin and iliac glands the other groin axillary neck and mediastinal involvement.

While there is no objection to the complete surgical removal of a localized group of glands if it is followed by radiation it does not seem to me that this is necessary.



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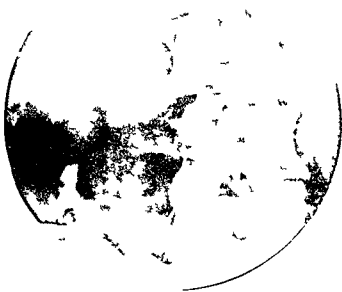


Fig. 3 (22534f) Left outline extended to show the position of the right ectopic kidney



Fig. 4 (7834) Left ectopic kidney, b. tract. in to left ureter, j. t. outside the bladder

frequency of the occurrence of misplaced kidney has been variously stated by different authorities. Naumann in 1897 reported 1 case in 10 177 necropsies at the Kiel pathologic institute. Gerard in 1903 estimated its occurrence as 1 in 500. Guizzetti and Pariset in 1910 reported 18 cases in 20 000 necropsies. Within the last two decades the condition has become of surgical interest and with the accurate means of diagnosis now used is steadily growing in clinical importance. Dorland in 1911 collected 11 clinical cases from the literature about 100 of which had been published since 1898. In less than one third of them the symptoms were due to displacement or disease in the ectopic kidney. Flummer in 1913 reported 67 cases collected by Straker in 1906 to which he added 17 making a total of 84 clinical cases. Operations were done in 63 of Straker's 67 cases 48 were some type of operation on the kidney.

Our series comprises 19 cases of ectopic kidney which have been selected from the records of the clinic. In 9 of these operations were done because of pathologic conditions in the misplaced kidney. In the remaining 10 cases the condition was discovered either during the course of some other operation or in making a routine examination of the kid-

ney. In these 10 cases the kidney while misplaced was not producing any symptoms and apparently was functioning normally.

#### ANATOMIC FEATURES

The ectopic kidney shows some distinct anatomic features mostly in its blood supply.



Fig. 5 (18408) Left ectopic kidney, b. tract. in to left ureter, j. t. outside the bladder

## ECTOPIC OR PELVIC KIDNEY

B. I. S. JUDD, M.D., & S. W. HARRINGTON, M.D., RES. MI. E. OFA.  
F. M. H. M. C.

**R**ENAL ectopia, or congenital malposition of the kidney, is a condition in which the kidney has never occupied its normal position, it is to be distinguished from the movable kidney which has wandered from its normal position. Renal ectopia is due to developmental defects of the renalanlage. The renal bud appears on the dorsal aspect of the Wolffian duct shortly after it has reached the cloaca as a thickening and bulging of the wall which soon develop into a narrow stalk capped with a mass of mesodermic tissue designed to be the future kidney. The bud grows dorsally during their process of development in a centromerion in front of the second sacral vertebra rotate to a lateral position on either side of the vertebral column and reach their normal position in the lumbar region about the end of the second month. It is not until after they have reached this position that they receive vascularization. The process of ascent and rotation may stop at any point during its course

or it may not be instituted at all, thus the kidney never reaches its normal height and becomes permanently fixed in an abnormal location. Variations in size and form often follow from its adaptation to its surroundings and are governed to some extent by environment and developmental defects. Often there is an associated defective development of Muller's duct which does not normally develop until after the primitive kidney has reached its final height which accounts for the frequent association of genital malformations with ectopic kidney.

Renal malposition is comparatively rare but occurs often enough to interest diagnosticians and a sufficient number of such cases develop pathologic conditions requiring surgical intervention to interest the surgeon. The condition has been recognized for centuries and was well known to the early writers of the sixteenth century but it was then of anatomic interest only. Cases were reported by Bauhinus and many others. The



F (4) left top kidney midline below (075) right kidney Pelvis  
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t r h t h t k d v m l p e t r m U t l t l t t  
Preserved before hernia 14 socia Bilateral fecund 8

movable from trauma or pregnancy. A pelvic kidney is much more frequently found on the left side than on the right and it is usually on the side where it normally belongs although crossed ectopic kidneys are quite often seen. Occasionally both kidneys are in the pelvis and rarely an ectopic supernumerary kidney may be found. The adrenal glands develop independently; they are always found in their normal position and never accompany the ectopic kidney. It is interesting to note the frequency with which genital malformations of both sexes are associated with dystopia of the kidney particularly in cases of single pelvic kidney. The genital defect if unilateral is found on the same side as the ectopic kidney. The more frequent defects are the imperfect development or the entire absence of the uterus and the vagina. There may be an absence of vulvar and urethral openings and atrophic and undescended testicle is often seen. In quite a number of the reported cases there has also been an imperfect development of the urinary bladder. Definite mental disturbances have been observed to be associated with ectopic kidney and are believed to be the stigmas of degeneration due to developmental defects. Ectopic kidneys are usually normal and although they are subject to all the pathologic conditions to which a normal kidney is subject they are only discovered by chance during an examination or at necropsy. When any lesion exists in the kidney there seems to be a tendency for it to become hydronephrotic probably because of the short ureter and poorly formed pelvis and ureter. The surrounding structures may also play a part in this condition. Stones are frequently found in these kidneys as is also cystic degeneration and tuberculosis.

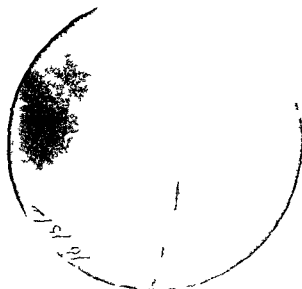
#### CLINICAL FEATURES

From clinical observations it appears that pelvic kidney occurs more often in females than in males but at necropsy it is found as often in the male. This is undoubtedly owing to the fact that the misplaced kidney in the female is more prone to cause symptoms which simulate disease of the uterus and adnexa and also menstrual disturbances. When the

ectopic kidney is pathologic the symptoms are the same as when the condition is present in a normally placed kidney. The diagnosis depends on the physical findings, the X-ray and the kidney examinations. The diagnosis ordinarily is not easily made but there are some physical findings which are of aid. The palpation of a tumor through the abdominal wall or rectum especially with the absence of the kidney from its normal position is suggestive of the condition. The absolute and relative fixation of the tumor and often the palpation of the lobulations of a kidney, the depression in the hilus and at times the pulsation of a large artery on its anterior wall may be noted. The presence of genital malformation associated with a pelvic tumor should lead one to suspect ectopic kidney. Cystoscopic examination and pyelography give the most accurate data and it is on these data that a definite diagnosis is made. Frequently the cystoscope reveals certain fairly characteristic features especially the pulsation in the trigone from an underlying large renal artery. The ureteral meatuses are usually normal but the ureter from the ectopic kidney is much shorter and may be coiled and distorted. The pyelogram shows the abnormal position of the pelvis and makes it possible to determine whether or not the kidney is pathologic. The presence of stones also is shown.

The differential diagnosis is more difficult in the female than in the male because of the frequency with which the ectopic kidney causes symptoms referable to the adnexa. In many instances a pelvic kidney has been called an ovarian cyst and explorations have been made with the idea that the condition is a cyst in one of the ovaries. A pyonephrosis in an ectopic kidney has been mistaken for pyosalpinx. The most common error in diagnosis in the male has been in differentiating between the dystopic kidney and inflammation in the appendix. In two of our cases it was quite difficult to determine whether the symptoms were being produced by the appendix which showed a slight degree of inflammation or whether the symptoms were produced by some infection which was located in the pelvic kidney.



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It is usually approximately normal in size when not diseased although it may be smaller than normal. It may be oval or pyramidal in contour depending somewhat on the surrounding structure and it may retain its fetal lobulation. The origin of the blood vessel supplying the misplaced kidney is

always lower than normal. The arterial supply is very liberal and many arteries entering the kidney have been reported. The vessel may come from the lower few inches of the aorta from a branch of the aorta or from both. The usual origin is the lower few inches of the aorta especially at the bifurcation but it may be the common iliac, the mid iliac or inferior mesenteric. As a rule the veins correspond to the arterial supply but in anomalous arrangements frequently found. The ureters generally shorter than normal usually take a short tortuous course to the bladder and enter it in the normal position. The pelvis of the kidney and the ureter are usually on the anterior side of the kidney and in this manner they retain their fetal relation. The pelvis is not always fully developed. The position that such a kidney is some vary greatly depending on the time at which the normal process of development ceases. Its most frequent location is entirely within the small pelvis behind the uterus to one side or resting on the promontory of the sacrum or sacro iliac joint. It is sometime located in the iliac fossa and rarely in the abdominal wall. It is usually firmly fixed in the position assumed due chiefly to its vascular pedicle. It may become



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the right side. The combined functional test was only 35 per cent in two hour. At operation a small kidney was found lying in the pelvis with a hydro-nephrosis and some infection. The ureteropelvic juncture was a definite stricture which was incised and a plastic operation done. The convalescence was satisfactory.

In the seventh case the chief complaint was left lower abdominal pain. The physical examination was negative with the exception of tenderness in this region. Obstruction was encountered 10 centimeters up the left ureter and a pyelogram showed that the left kidney was lying in the pelvis and that the pelvis of the kidney and the calyces were dilated. The arterial and venous blood supply was characteristic of an ectopic kidney. A nephrectomy was done and the patient made a good recovery.

In the eighth case the patient complained of a combined urinary and fecal fistula in the left inguinal region. The fistula had persisted since an operation for the drainage of a large abscess in this region some weeks previously. Soon after drainage was established stones, urine and feces began to discharge. Examination revealed an obstruction of the ureter and X-ray examination showed multiple stones in the pelvis and calyces of a pelvic kidney. Two subcapsular operations were performed the infected kidney tissues and a large number of stones were removed.

In the ninth case the patient had complained of pain through the pelvis and a left hydronephrotic pelvic kidney was discovered during an exploration. The diseased kidney was removed and the patient made a good recovery.

In one case an exploration was made which revealed an absence of the right kidney and a congenital malformation of the liver and duodenum. The left kidney was large and was situated in the region of the sacroiliac joint. Fortunately the absence of the opposite kidney was discovered before anything had been done to the pelvic kidney.

In four of the series the condition of congenital misplacement of the kidney was discovered during the course of some other operation and in most instances the position and condition of the kidney probably had nothing to do with the production of the patient's symptoms. In two cases the kidneys were discovered while an operation was being performed for appendicitis and in both instances the appendix showed definite inflammation. In view of the fact that the symptoms subsided after the appendix had been removed the position of the kidney apparently had nothing to do with the symptoms. One of these patients a young married woman came for consultation because of repeated miscarriages. The pelvic kidney was thought at first to be an ovarian cyst but on exploration it was found to be a kidney apparently in good condition.

The uterus was lifted up in the pelvis by shortening the ligaments nothing was done with the kidney. I was unable to get a late report in this case so do not know whether the condition was remedied. In one case the pelvic kidney was discovered while an operation was being done for congenital absence of the vagina.

In five cases of the series the malposition of the kidney was discovered in a routine examination by means of a pyelogram. In all of the five cases the kidney was apparently normal with the exception of its position. In two instances the pelvic kidney was found to be a solitary kidney. In one there was lack of development in other regions and in one there was a reduplication of the pelvis (Figs 1-8).

#### SUMMARY

In conclusion it may be stated that this particular malposition of the kidney occurs rarely. The kidney may functionate in a perfectly normal manner in this position and it may never be discovered or if discovered it will not require treatment. The condition is of interest when the kidney becomes involved in some pathologic process such as hydronephrosis, pyonephrosis or tuberculosis. Under these conditions the location of the kidney may be misleading in the diagnosis which however can accurately be made by a careful examination of the bladder, meatus and kidney by means of the cystoscope, the ureteral catheter and the pyelogram. After the diagnosis has been established the treatment is the same as for a pathologic condition of a kidney in its normal location.

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## TREATMENT

From a surgical point of view the treatment of ectopic kidney differs in no essential from the treatment when the organ is in its normal position. The mere fact that the kidney did not rise to its normal position does not indicate that it requires treatment. If the kidney is functioning normally in its malposition under ordinary circumstances it should not be disturbed. A few instances have been reported in which a kidney in the pelvis was interfering with pregnancy and apparently was the cause of repeated miscarriages. In such cases it might be advisable to attempt to raise the kidney to a higher position. Ordinarily it is difficult to change the position of the ectopic kidney because the blood vessels in the pedicle are short and the kidney is rather firmly fixed. In some cases however in which the kidney is producing symptoms such as would be caused by an intermittent hydronephrosis although the function may be normal it would seem advisable to attempt to change its position and possibly to do a plastic operation at the point of obstruction. This was done in one of our cases and quite a satisfactory result was obtained. In some of the reported cases in which a nephrorrhaphy had been done it was necessary subsequently to remove the kidney.

The problems presented by the ectopic kidney during pregnancy and parturition are often difficult to decide but fortunately most deliveries are accomplished without surgical intervention. We have not observed a case of pregnancy complicated in this manner but from reported cases it would seem that the amount of hindrance to labor depends on the amount of narrowing of the true pelvis and also on the degree of fixation of the kidney. It has been suggested that if the condition is noted early in the pregnancy and if it seems to narrow the pelvic inlet sufficiently to hamper labor an attempt should be made to anchor the kidney above the brim of the pelvis. It has also been suggested that a nephrectomy should be done under such conditions but we believe that instead of doing a nephrectomy which might be quite a serious procedure it would be best to wait until

during the last stages of pregnancy and then perform a cesarean section.

The surgical treatment of pathologic conditions in the ectopic kidney is practically the same as for like conditions in normally placed organs. In all cases in which there is destruction of kidney tissues impaired function and a normal kidney on the opposite side a nephrectomy is certainly indicated. Before considering nephrectomy in such cases however it is very important to determine the condition of the opposite kidney. In three of our cases the ectopic kidney was solitary and in all it seemed to be the cause of the symptoms.

## REVIEW OF 19 CASES

Nine of the nineteen cases of ectopic kidney of this series were operated on for some pathologic condition in the kidney.

In one case an exploration was made to determine the nature of a pelvic tumor which proved to be a fairly good kidney lying within the pelvis. It was freed from its pelvic attachment and a fixation was made as high up as possible. This seemed to relieve the patient for some time but she returned in fourteen months with symptoms somewhat the same.

In the second case a diagnosis of a functionless right kidney with hydronephrosis and tumor was made. An exploration revealed an ectopic kidney. Nephrectomy was done with satisfactory recovery.

In the third case the patient gave a history of grill bladder trouble. Physical examination revealed a rather firm mass in the right abdomen and a fluctuation indicated the mass to be an ectopic kidney which was freed and fixed in a higher position. The condition of the grill bladder was remedied at the same time. This patient's convalescence was uneventful.

In the fourth case the patient complained chiefly of female trouble namely attacks of pelvic pain and other troubles which required rest in bed for several days at a time. Examination showed a small mass in the left iliac fossa and a deformity of the sigmoid uterus. At operation a pyrophosphoric kidney was found. The ureter was about the same length and there were three enlarged calyces all common from the common iliac. The kidney was removed. Convalescence was satisfactory except for a phlebitis in one of the superficial veins.

In the fifth case the complaint was kidney trouble. Bacilli of tuberculous had previously been found in the urine and a diagnosis of tuberculous of the right kidney was made. At operation the kidney was definitely tuberculous and as situated in the right iliac fossa. The blood supply came from three large vessels from the lower aorta.

In the sixth case the complaint was of frequent and painful micturition and a cystocele. The cystoepic examination showed a pyonephrosis on

hesions accounts for retention of the testicle in 96 to 97 per cent of the cases and that the instances in which a congenital origin of retention is apparent will amount to not more than 2 to 3 per cent

Uffreduzzi disagrees entirely with Buedinger's conclusion and in regard to the great frequency of such cicatrices he states that no other investigator has found them in any such proportion as Buedinger. Lanz stated that he found no such cicatrices in any of his 51 cases nor did Uffreduzzi himself observe a single such case.

My own observations based upon our experience at the Hospital for Ruptured and Crippled and other hospitals are in accord with Uffreduzzi. I have found no evidence of old adhesions. Uffreduzzi lays far more stress upon the element of heredity as a cause of ectopia, a theory first advanced in the classical paper of Godard's. The latter states that the descent of the testicle as it takes place in man is nothing but an example of the phylogenetic migration as it gradually takes place in zoological evolution. Hence some authors consider retention of the testicle a simple continuation of a condition that is normal in certain animals and that a retained testicle must be looked upon as a sign of arrested development.

I have personally operated upon a boy of thirteen years with double abdominal ectopia who has a younger brother of 1 also with abdominal ectopia.

Uffreduzzi states that in the great majority of cases of ectopic testicle there are other signs of degeneration. In 24 cases examined by himself he invariably found a greater or less number of distinct anomalies physical as well as mental. In one case bilateral cryptorchidism was associated with true hermaphroditism. This extremely rare form of hermaphroditism of which only two other cases are recorded in the literature represents one of the most serious forms of degeneracy known.

On basis of his investigations Uffreduzzi concludes that retention of the testicle is hardly ever an isolated fact but merely a local expression of infantilism i.e. of a serious retardation in the development of the entire individual which may be more or less pro-

nounced and is nearly always accompanied by other bodily or mental abnormalities.

Uffreduzzi has made an exhaustive study of the literature with reference to developmental anomalies of this kind in idiots and mentions Bournville and Sollier's statistic comprising 758 cases of idiots which show such anomalies as phimosi, hypospadias, atrophy, retention of the testicle, various malformation of the penis in a considerable number of cases.

Knecht's statistic covering 379 individuals belonging to this group shows phimosi 51 times, bilateral retention of testicle 11 times, atrophy of the testicle 18 times, epispadias twice, hypospadias 5 times, varicocele 12 times.

Uffreduzzi's own examinations made at Morro's Institute for Insane covering 100 cases show 47 simple epileptics, 7 epileptic idiots, 12 cretins, 14 phrenothenesics. In 18 of these 100 cases he found an ectopic testicle (6 bilateral and 12 unilateral).

Personally I believe that Uffreduzzi goes somewhat too far in his claim that in the great majority of cases of ectopic testicle there are other signs of degeneration. I believe a study of the statistics will show that while these various types of abnormal mental development have associated with them a large proportion of undescended or mal-descended testis it does not necessarily follow that the reverse is true. Such a statement as Uffreduzzi's should be based upon evidence obtained from a very large number of cases of undescended testis. Our own observations at the Hospital for Ruptured and Crippled based upon 1357 cases of undescended testis show that marked signs of physical or mental abnormalities are only associated with double undescended testis and in but a moderate proportion of these. As regards the unilateral undescended or mal-descended testis we have found no evidence showing that this is usually or frequently associated with other abnormalities.

As regards the pathology of the undescended testis owing to the fact that we have from the beginning strongly advocated attempting to save the undescended testicle and not to sacrifice it we have had very little material

# OPERATIVE TREATMENT OF UNDESCENDED OR MAL-DESCENDED TESTIS WITH ESPECIAL REFERENCE TO END-RESULTS

## A REPORT OF 415 CASES<sup>1</sup>

By WILLIAM B. COLEY, M.D., F.A.C.S., New York.  
 At a regular meeting of the Medical Society of the City of New York, December 1, 1904.

**I**N the Outpatient Department of the Hospital for Puerperal and Crippled from 1890 to 1918 there have been observed 80,730 cases of inguinal hernia in the male of which 1.35, or 1.68 per cent were associated with undescended or mal-descended testis. From 1890 to 1918 4,453 cases of inguinal hernia in the male have been operated upon of which number 3.54, or 1.5 per cent were associated with undescended testis.

Of 1,040 cases of hernia in adults operated upon at the Memorial Hospital by Dr. William A. Downes and the writer 49, or 4.71 per cent were associated with undescended testis.

In a paper read before the New York Surgical Society on April 22, 1908 I reported 126 cases of undescended testis which I personally operated upon and which had been traced as far as possible to end results.

While a number of articles have been written upon the subject since that date there is still more or less doubt in the mind of the medical profession as to the indications for surgical treatment and still a wide difference of opinion as to the best method of operation. Even at the present time no large statistics exist in which the end results of operative treatment have been given and the present paper has been written chiefly with the hope that some further light may be thrown upon the question as to the condition of patients with undescended testis many years after operation.

In my earlier paper I dwelt with considerable detail upon the various theories as to the causative factors connected with the development of the undescended or mal-descended testis and described the various types of undescended or mal-descended testis usually observed.

As regards the etiology of the condition the theory that a mechanical obstruction of

some sort due to inflammation adhesions formed during foetal life is the principal cause has been strongly advocated by Buedinger and has found many adherents. Buedinger operated upon 4 cases of undescended testis of the inguinal variety and states that he found mechanical obstruction of some sort in 15 of these 4 cases.

As I stated in my former paper Odierne and Simmons of Boston have made an important contribution to our knowledge of the pathology of the undescended testis in their paper published in the *Annals of Surgery*, December, 1904. They found a marked tendency to thickening of the tunica albuginea in nearly all of the specimens examined and an increased amount of interlobular connective tissue.

More recently Uffreduzzi of the Carle's Clinic in Turin has made perhaps the most exhaustive study of the pathology of the retained testicle that has yet been published.

His observations upon the etiology of the undescended testis are of special interest. He states that the explanations offered by many of the earlier writers are exceedingly naive in that these writers frequently confound the cause of the anomaly with its result. Kocher explained the incomplete descent of the testis as well as the atrophy of the gland by an inflammatory process during intra-uterine life but was unable to support his hypothesis by objective findings. The theory that the non-descent of the testis is dependent upon mechanical obstruction due to peritoneal adhesions occurring during foetal life was originally advanced by Cloquet and Wrisberg and later strongly advocated by Buedinger and supported by numerous necroscopic and operative findings. Buedinger goes so far as to state that in his opinion mechanical obstruction caused by such ad-

difference of opinion some writers going so far as to state that it has no functional value whatever and for that reason advocate its removal. Uffreduzzi believes that a considerable number of undescended testes to per cent retain the power of reproduction. While the data at present is insufficient to enable one to express a positive opinion it is probable that Uffreduzzi's estimate is not far from correct. Aside from any functional value that the testis may possess there is another strong ground for preserving it particularly in children and that is for the reason that the interstitial cells which are always present have an important influence in developing the male characteristics of the child.

From January 1 1890 to January 1 1918 there have been operated upon at the Hospital for Ruptured and Crippled 334 cases of undescended testis and since that time 31 additional cases (of these cases 50 were operated upon by the writer personally and the remainder by William T. Bull, John B. Walker, William A. Downes, J. P. Hoguet and the assistant surgeons) adding to these 50 cases operated upon at the Memorial Hospital we have a total of 415 cases of undescended testis. A most careful attempt has been made to trace these to final results.

In 40 cases the testis was found in the vicinity of the external ring just above the pubic bone. In 17 cases it was found in the upper scrotum. In 4 cases in the mid scrotum and in 16 cases it was impossible to locate it in any position (probably it had retracted in the abdominal cavity or had become too atrophied for palpation).

Age as far as known of patients operated upon for undescended testis

|                | Cases |
|----------------|-------|
| Under 5 years  | 33    |
| 5 to 10 years  | 160   |
| 10 to 15 years | 133   |
| 15 to 20 years | 29    |
| 20 to 30 years | 16    |
| 30 to 40 years | 1     |
| 40 to 50 years | 5     |
| Over 50 years  | 1     |
| Total          | 384   |

The different varieties of ectopia or mal position of the testis are associated with

slightly different types of sac or variations in the size and location of the vaginal peritoneum.

The most common type of ectopia is that in which the testis occupies a position in the inguinal canal between the internal and the external ring. An interesting point in connection with this form of ectopia is that while the testis never goes beyond the external ring the tunica vaginalis may extend down beyond the external ring even beyond the bottom of the crutum. In certain cases this pouch passes beneath the deep fascia and finds its way down into the perineum and in some still more rare cases it passes down into the thigh.

The next most common type of ectopia is that known as inguino superficial in which the vaginal process passes out of the external ring then turns directly backward and upward and extends to 3 inches toward the anterior superior spine. In these cases the testis usually occupies the distal portion of the sac and rests on the outer surface of the aponeurosis directly beneath the skin and superficial fascia.

It is evident that a diagnosis should be made in these cases before operation otherwise in cutting down to the aponeurosis the first landmark of the incision for Bassini's operation one would first pass through the testis before reaching the aponeurosis. The testis can be so easily felt in this superficial condition that a diagnosis should practically without exception be made.

This type which was a few years ago regarded as extremely rare is comparatively common. seventy seven cases having been observed in the statistics which have been kept at the Hospital for Ruptured and Crippled.

Another type is the inguino perineal in which the vaginal process for some unknown reason instead of entering the scrotum passes beneath the deep fascia and extends into the peritoneum for a varying distance sometimes reaching nearly to the anus. I have observed 8 cases. In these cases the cord is usually normal in length and by making a new pouch in the scrotum the testis and cord can easily be transplanted in the scrotum without any tendency to retraction. In

for pathological investigation Uffreduzzi states that the structure of the retained testicle varies greatly in the individual cases. The principal changes that are nearly always found are thickening of the tunica albuginea and of the basement membrane of the tubules and a great increase in interstitial cells. The epithelial lining of the tubules also shows very marked changes the epithelial cells being few in number and more or less degenerated and irregular in shape.

In a chapter on the pathology of the retained testicle Uffreduzzi discusses the various complications that are apt to accompany the condition of ectopic testicle and which in order to differentiate them from the congenital complications he designates as secondary or acquired. Among these are prun and nervous disturbance specific or chronic inflammation gangrene and in circation of the testicle torsion of the cord in a series of 80 cases of torsion of the cord collected by Uffreduzzi a retained testicle was found in 60 per cent.

The most common complication of undescended testicle is hernia of the congenital type although in rare cases it may be acquired. In all but two or three cases we have found a potential or actual hernia of congenital origin. Further complications are hydrocele of the cord and neoplasm.

That the retained testicle frequently becomes the seat of tumors was first claimed by Lecomte in 1851 and has since been confirmed by many others.

In my former paper on the Treatment of the Undescended or Mal descended Testis I stated that there was considerable difference of opinion in regard to the question of whether the undescended testis predisposes to malignant degeneration and cited the various views pro and con. McAdam Eccles in his Jacksonian Prize Essay 1903 stated that he had made an examination of 48 000 males with hernia at the London Truss Society and found 1 per cent or 854 cases with undescended or mal descended testes. Yet in this entire series there was not a single case of sarcoma observed. He further stated that of 40 cases of sarcoma of the testis observed in one of the

large London Hospitals during a period of 20 years there was only one case of sarcoma of the undescended testis. From this fact he concludes that the generally accepted opinion that malignant disease is more common in the undescended than the normal testis is not well founded. For many years I was inclined to agree with Eccles' opinion but further observations convinced me that it was wrong.

In my paper upon Cancer of the Testis with a report of 64 cases read before the Southern Surgical and Gynecological Association December 15 1914 I stated that in 12 cases the sarcoma or malignant disease was associated with an undescended testis and discussed the question of the relative frequency at considerable length. Different writers give different opinions as to the relative frequency of cancer of the normally descended and mal descended testis. Odiorne and Simmons in a review of 54 cases of malignant disease of the testicle observed at the Massachusetts General Hospital found 6 or 11 per cent in which the disease occurred in the undescended testis of these four were in the abdominal cavity and two in the inguinal canal. Rydmacher gives the proportion of malignant abdominal to malignant inguinal testicle as 1 to 8. Meiser found 64 malignant inguinal against 4 abdominal testis. Bulkley however at the Presbyterian Hospital found 2 cases of malignant abdominal to 12 cases of malignant inguinal testis. An analysis of the cases observed by Chevassu Odiorne and Simmons and the Presbyterian Hospital records show the proportion as 1 to 5. My own statistics show almost the same proportion viz 12 undescended testis in a total of 64 cases of sarcoma of the testis or about 1 to 5  $\frac{1}{2}$ .

If sarcoma of the testis shows a relative proportion of incidence of 1 in the undescended testis to 5<sup>1</sup> or even 8 in the testis in the scrotum we have only to show that the relative proportion of undescended testis to normally placed testis is about 1 in 50 to prove that the abnormally placed testis is more prone to malignant disease than the normally placed.

With regard to the functional value of the undescended testicle there is still a wide

One patient 12 years old traced 10 years position of testis not stated

One patient 7 years old traced 11 years testis atrophied lying on top of external oblique

One patient 10 years old traced 10 years The testis was situated well down in scrotum and was half the normal size

One patient 18 years old traced 10 years—double one side in scrotum  $\frac{2}{3}$  normal size—other side not felt

### Cases traced from 5 to 10 years

One 5 years old traced 7 years testis atrophied outside of external ring

One 9 years old traced 8 years testis normal size at bottom of scrotum

One 11 years old traced 6 years testis just with out external ring

One 4 years old traced 5 years position of testis not stated

One 11 years old traced 8 years testis down and normal in size

One 5 years old traced 6 years position of testis not stated

Double inguino superficial 10 years old traced 5 years position of testis not stated

Boy 8 years inguino superficial traced and well 5 years position of testis not stated

Double 11 years old traced and well 8 years size of testes not stated right in scrotum left in mid scrotum

Double inguino superficial boy 12 years old traced 9 years position and size of testes not stated

Boy of 4 traced 5 years position of testis not stated

Boy of 14 inguino superficial traced and well 9 years position of testis not stated

Boy of 7 traced 9 years testis can be easily pulled down into bottom of scrotum

Boy of 14 double traced 7 years right testis inguinal left abdominal type position of testes not stated

Boy of 13 properitoneal traced 7 years testis outside of external ring freely movable

Boy of 6 traced 6 years testis small at bottom of scrotum

Boy of 11 traced 6 years testis half normal size position external ring

Boy of 4  $\frac{1}{2}$  traced 8 years testis not felt

Boy of 8 traced 8 years testis just above external ring

Boy of 5 traced 5 years testis at external ring

Boy of 11 traced 5 years both testes in bottom of scrotum

Boy of 14 traced 5 years position of testis not stated

Boy of 13 double inguino-superficial traced 5 years both testes in scrotum and freely movable

Boy of 10 traced 3 years position of testis not stated

Boy of 9 traced 5 years position of testis not stated

### Final results in the cases observed at the Hospital for Ruptured and Crippled

| Traced                  | N mb | 1 C se |
|-------------------------|------|--------|
| More than 20 years      |      | 1      |
| From 10 to 20 years     |      | 16     |
| From 5 to 10 years      |      | 41     |
| From 2 to 5 years       |      | 60     |
| From 1 to 2 years       |      | 31     |
| From 6 months to 1 year |      | 1      |
| Less than 6 months      |      | 15     |
| Not traced              |      | 149    |
| Total                   |      | 334    |

In the cases of adults as far as results are known the testis has shown a greater tendency to remain in the scrotum than in children. The most important end result in an adult is that in the case of W N male who had double undescended testes 30 years who was operated upon in 1895 on the left side by Dr Schoonmaker of Yonkers and in 1910 on the right side by myself at the Memorial Hospital. He was married in 1902 and had a child born in April 1903.

This case is of particular interest inasmuch as it is the second case that I have been able to find recorded in which a patient suffering from double undescended testes has become a father.

### Another interesting case

W G 37 years old was operated upon 23 years ago for a right undescended testis. I had an opportunity of examining this patient on December 11 1918 and found the testis absolutely in the bottom of the scrotum. It was normal in size and felt just a little less firm in consistence than the opposite testis. The patient was married two years ago and up to the present time has had no children. In this case I think the longest period has elapsed since the operation (23) years.

### CONCLUSIONS

A careful study of our cases together with the literature of the subject has led to the following conclusions.

1 That in most cases of undescended or mal descended testis the etiology points to a congenital origin often influenced by the element of heredity and frequently associated—particularly in the double variety—with other developmental defects.

2 The atrophy usually found in the undescended or mal descended testis is not the



some of these cases the testis is normal in size and in other cases it is atrophied

In a considerable number of cases a bilocular sac has been found in which the testis occupies the upper loculus which lies between the inner and external oblique muscle the lower portion of which extends into the scrotum. In a smaller number of cases I have observed a bilocular sac in which the upper portion assumes the inguino superficial variety resting upon the aponeurosis is beneath the skin and superficial fascia and the lower loculus extending down into the scrotum. In these cases the testis usually occupies the upper loculus

*Operative procedure* The method employed at the Hospital for Ruptured and Crippled since 1890 has been practically the Bassini operation without transplantation of the cord namely Bassini's incision freely opening the aponeurosis of the external oblique well beyond the internal ring surrounding the cord and hernial sac which latter has always been found present with only two exceptions. Then the lower portion of the tunica vaginalis is grasped by an artery clamp and by traction the testicle is brought down as far as possible. The next step is separation of the sac from the cord high up just outside the internal ring. In children this requires very careful and delicate dissection with thumb forceps as the cord is usually greatly enlarged and spreads out in a fan like manner over an area of the sac one inch in width. If the dissection has been begun at the right layer the sac can be easily isolated and is then tied off as high as possible. In most cases of inguinal and in many cases of the abdominal ectopia the cord can be freed sufficiently to permit the testicle to be brought at least into the upper portion of the scrotum in most cases into the lower part with the sacrifice of but few if any of the veins. Except in a very few of the early cases I have never made any attempt to anchor the testis in the scrotum but rely upon careful freeing of the cord high up and the removal of all fascial bands. Suturing of the testicle within the scrotum is in my opinion of little value. If there is any tension the scrotum is retracted up toward the external ring. The

canal is then closed by the modified Bassini method without the transplantation of the cord. The cord is brought out at the lower end of the wound. The internal oblique is then sutured to Poupart's ligament over the cord. Great care is taken in placing the lowermost suture which should include the reflected portion of the external oblique as well as the conjoined tendon and Poupart's ligament on the other side. This suture when tied makes but a very small external ring too small ever to permit the testis to retract into the canal even should it reach the ring.

In cases in which it is found difficult to get the testis into the scrotum and this is particularly true in the abdominal variety of ectopia the admirable procedure advocated by Bevan has been found of great value. In these cases we may remove not only the fascial bands but practically all the veins and vessels with exception of the vas and the spermatic artery.

Another excellent feature of Bevan's technique described in the *Journal of the American Medical Association* 1903 is a purse string suture in the region of the external ring including the superficial and deep fascia which not only prevents the testicle from entering the canal but also from passing up on top of the aponeurosis.

Brief notes regarding patients traced from 10 to 20 years

One patient 5 years old traced 19 years test in good position

One patient 3 years old traced 20 years testis atrophied and retracted to external ring

One patient 1 year old traced 19 years testis normal patient married and has 10 children

One patient 2 years old traced 4 years testis found in normal condition

One patient 6 years old traced 13 years testis not felt

One patient 12 years old traced 11 years testis just below external ring

One patient 11 years old traced 11 years testis not found

One patient 1 years old traced 1 years testis not felt

One patient 2 years old traced 12 years testis normal in size and position

One patient 4 years old traced 2 years testis found in inguinal region superficial to aponeurosis

One patient 1 years old traced 1 years testis atrophied and situated at the spine of the pub

One patient 12 years old traced 10 years position of testis not stated

One patient 7 years old traced 11 years testis atrophied lying on top of external oblique

One patient 10 years old traced 10 years The testis was situated well down in scrotum and was half the normal size

One patient 18 years old traced 10 years—double one side in scrotum  $\frac{2}{3}$  normal size—other side not felt

### Cases traced from 5 to 10 years

One 5 years old traced 7 years testis atrophied outside of external ring

One 9 years old traced 8 years testis normal size at bottom of scrotum

One 11 years old traced 6 years testis just with out external ring

One 4 years old traced 5 years position of testis not stated

One 11 years old traced 8 years testis down and normal in size

One 5 years old traced 6 years position of testis not stated

Double inguino superficial 10 years old traced 5 years position of testis not stated

Boy 8 years inguino superficial traced and well 5 years position of testis not stated

Double 11 years old traced and well 8 years size of testes not stated right in scrotum left in mid scrotum

Double inguino superficial boy 12 years old traced 9 years position and size of testes not stated

Boy of 4 traced 5 years position of testis not stated

Boy of 14 inguino superficial traced and well 9 years position of testis not stated

Boy of 7 traced 9 years testis can be easily pulled down into bottom of scrotum

Boy of 14 double traced 7 years right testis inguinal left abdominal type position of testes not stated

Boy of 13 properitoneal traced 7 years testis outside of external ring freely movable

Boy of 6 traced 6 years testis small at bottom of scrotum

Boy of 11 traced 6 years testis half normal size position external ring

Boy of  $4\frac{1}{2}$  traced 8 years testis not felt

Boy of 8 traced 8 years testis just above external ring

Boy of 5 traced 5 years testis at external ring

Boy of 11 traced 5 years both testes in bottom of scrotum

Boy of 14 traced 5 years position of testis not stated

Boy of 13 double inguino-superficial traced 5 years both testes in scrotum and freely movable

Boy of 10 traced 3 years position of testis not stated

Boy of 9 traced 5 years position of testis not stated

### Final results in the cases observed at the Hospital for Ruptured and Crippled

| Traced Well             | Number | Percentage |
|-------------------------|--------|------------|
| More than 20 years      | 1      | 1          |
| From 10 to 20 years     | 16     | 16         |
| From 5 to 10 years      | 41     | 41         |
| From 2 to 5 years       | 60     | 60         |
| From 1 to 2 years       | 31     | 31         |
| From 6 months to 1 year | 1      | 1          |
| Less than 6 months      | 15     | 15         |
| Not traced              | 149    | 149        |
| Total                   |        | 334        |

In the cases of adults as far as results are known the testis has shown a greater tendency to remain in the scrotum than in children. The most important end result in an adult is that in the case of W N male who had double undescended testes 30 years who was operated upon in 1895 on the left side by Dr Schoonmaker of Yonkers and in 1910 on the right side by myself at the Memorial Hospital. He was married in 190 and had a child born in April 1903.

This case is of particular interest inasmuch as it is the second case that I have been able to find recorded in which a patient suffering from double undescended testes has become a father.

### Another interesting case

W G 37 years old was operated upon 23 years ago for a right undescended testis. I had an opportunity of examining this patient on December 11 1918 and found the testis absolutely in the bottom of the scrotum. It was normal in size and felt just a little less firm in consistence than the opposite testis. The patient was married two years ago and up to the present time has had no children. In this case I think the longest period has elapsed since the operation (23) years.

### CONCLUSIONS

A careful study of our cases together with the literature of the subject has led to the following conclusions:

1 That in most cases of undescended or mal descended testis the etiology points to a congenital origin often influenced by the element of heredity and frequently associated—particularly in the double variety—with other developmental defects.

2 The atrophy usually found in the undescended or mal descended testis is not the

result of the mal position. The change in structure and the atrophy are merely coincident being due to congenital causes.

3 The question of the functional value of the undescended testis cannot be definitely answered in an individual case. It may be stated however as a general rule that an undescended or mal descended testis with which there is associated a marked atrophy has little or no functional value. However I believe with Uireduzzi that in a considerable number of cases of undescended testis spermatogenesis is retained.

4 The ectopic testicle is practically always associated with an open vaginal process of peritoneum and there is usually present a potential hernia. This vaginal process is almost invariably a congenital affair for the reason that its position is entirely independent of the location of the testis.

5 Torion of the cord is more frequently observed in the undescended testis than in the normal testis.

6 The undescended testis shows a greater tendency than the normal testis to malignant degeneration.

7 Operation should be advocated in children who have reached the age of 8 or 10 years for the following reasons: (a) Operation permits the radical cure of the hernia with which the undescended testis is practically always associated and which often cannot be controlled with a truss without causing pain and irritation to the testis. (b) By bringing the testis down into the scrotum before the age of puberty there is a possibility of causing further and more normal development of the testis.

8 Operation in adults or children over the age of 14 should be even more strongly urged for the following reasons: (a) In order to cure the accompanying hernia as has already been stated. (b) in order to place the testis in a position in which it is much less subject to trauma. (c) in order to lessen the chances of malignant degeneration.

9 The end results in our series show that it is possible to cure the hernia in practically all cases. Unfortunately in only a comparatively small number of cases did we find the testis occupying the bottom of the scrotum

in the cases observed several years after operation. The atrophied testicle is generally found to have retracted to mid scrotum or in the region of the external ring and in a position somewhat less liable to trauma than before operation. The result accomplished by the operation the cure of the accompanying hernia would seem to justify advocating operation for the undescended testis in adults.

10 The question of whether the traumatism incident to the operation on the undescended testis might not favor the development of malignant disease is one that should be considered — however at present it cannot be answered definitely. It should be noted that in none of the series of cases operated upon at the Hospital for Puptured and Crippled during the past twenty nine years has malignant disease been known to develop however I have personally observed one case of sarcoma of the testis in which the disease was either present at the time or developed shortly after the operation for undescended testis possibly it had already started at the time the operation was performed. (The operation was performed by another surgeon.)

These conclusions differ slightly from the conclusions of my earlier paper. In that paper I stated that the undescended testis is almost invariably of little or no functional value. I believe this statement is somewhat too strong and should be modified to the extent that the undescended testis is probably of functional value in not more than 10 per cent of the cases.

I still believe that the undescended testis should never be sacrificed in children and that the practice which obtains in some of our hospitals of removing the undescended testis in a large number or even in the majority of cases is greatly to be deprecated. Even if the testis be of little functional value it nevertheless is of great value in developing the male characteristics in the child and promoting general health. In the adult it should likewise be retained for its influence upon the mentality and for the moral effect if for no other reason.

As regards the age for operation I still believe that operation is seldom indicated



lation now generally utilized Proctoclysis drop method of 5 per cent sodium bicarbonate solution six hours daily proves of wonderful efficacy in restoring the functions of a dilapidated old man undermined by urinary obstruction retention infection pain recurrent chills and fever But *efficient drainage* is the *sine qua non* of all requirements before during or after operation Interrupted catheterization in no sense fulfills the demands in urgent cases It occasions much suffering each time it is used in the badly inflamed cases and is often attended with steadily increasing difficulty of introduction all of which is done away with by binding the catheter in the urethra with string and a few pieces of adhesive plaster judiciously applied Nothing gives such immediate comfort as this in many instances and once attained such drainage can be continued until the critical situation is over and all things are favorable or as nearly so as they may be made for the operation It gives opportunity for daily irrigations whose effects may be both soothing and antiseptic In a particularly difficult and complicated case of 70 years of age the writer kept a catheter in the urethra for nine months before bringing the patient to a condition appropriate for operation after which the operation was done with success and prompt recovery

Hæmoglobin above 60 per cent is favorable 50 per cent is questionable 40 per cent unfavorable 30 per cent fatal in connection with prostatectomy

While the phthalein output should be above 30 per cent for two hours to present a promising outlook I believe the requirements are not so rigid as with the hæmoglobin percentage and that patients can be carried through to success in the face of very low phthalein percentage if all precautions are taken in regard to preparation anaesthesia and postoperative care At least we have had such experiences Low phthalein returns do not lead us to abandon operation but impel us to adopt all the different measures of safety and conservatism that have been instrumental in lowering the death rate of prostatectomy of late years

A peculiar fact pertaining to some cases

of chronic prostatic obstruction apparently in fair general condition is that they are really on the verge of a renal break down ready to be toppled over into urinary suppression and death by any untoward or unusual circumstance This portentous condition (impending acidosis) is often to be detected not so much by the quantity of urine passed in 4 hours as by the quality An enormous quantity of clear limpid urine is poured out but of low specific gravity (1.003-1.005) and lacking in solids and urea content Acetones may be present Beware of such cases and instill the therapeutic measures with the utmost caution from every standpoint Activity or inactivity is liable to be equally disastrous The patient has simply postponed the definite effort at recovery for too long a time He has reached a dangerous state and doesn't for a moment suspect it I have seen such patients dead in two or three days from the time of the upset and without any operation being undertaken or any serious measures being adopted Suppression of urine uræmia acidosis whatever the terms applied the outcome is death and represents the fallacy and danger of procrastination

#### CHOICE OF OPERATION

Without going into a discussion of the merits and demerits of the two methods of removal of the prostate suprapubic and perineal the writer after a considerable experience with both has adopted the suprapubic method as the one of choice *because it gives the better results* It is free from a number of momentous objections that unavoidably pertain to the perineal operation such as ineffectual urinary control sexual disability urethrorectal fistula etc

*One or two stage operation* While a one stage suprapubic prostatectomy may with confidence and safety be carried out in a patient of middle age and good general condition there is no doubt about the marked and distinct advantages presented by the same operation done in two stages in the decrepit patient of advanced years and weakened resisting powers The opportunity presented by the two stage operation of establishing a firm adhesion between



burg posture is not as innocuous as it is generally considered to be so that its duration should be shortened as much as possible. It is desirable to have the dome of the bladder project well up into the wound. This may be effected by adding if necessary a few ounces of fluid to the contents of the bladder through the catheter which still lies in the urethra.

At the bottom of the wound and still covering the bladder are the loose prevesical tissues and the lowermost fold of the peritoneum so merged together that they are not always distinguishable. Not a few good operators have inadvertently cut the peritoneum and have had to take time to stop and sew it up—in unnecessary delay. The writer avoids this by invariably laying aside the knife and using the gauze covered forefingers to separate the tissues strip up the peritoneum and definitely expose the bladder. The latter is recognizable by its muscular bundles and large veins. Three retractors maintain the exposure right left and upward the latter with a piece of gauze under it to prote t the peritoneum which is pushed well upward.

6 Then removing one lateral retractor a chromotized catgut fixation suture is placed. It is passed through the fascia and muscle (rectus) of one side then penetrating the full thickness of the musculature of the bladder at a point  $\frac{3}{4}$  inch from the midline it is directed downward for  $\frac{3}{4}$  inch before emerging passing again through the rectus muscle and fascia of the same side. Another suture is applied similarly on the opposite side after which a third is applied crosswise above just below the margin of the peritoneum. These three sutures when tied later draw the bladder up squarely against the under surface of the abdominal wall making a firm agglutination that prevents the burrowing or spreading of infection that is one of the most serious complications of suprapubic cystotomy. At present the sutures are left untied and are used as anchorages on the bladder wall. The bladder is now emptied by attaching a long rubber tube to the catheter and syphoning the contents into a waste basin.

This allows the apex of the bladder to sink down into the pelvis but it is readily brought back and controlled by means of the three fixation sutures.

7 A narrow sharp bistoury is made to puncture the bladder wall (always anticipating with local anesthesia) the incision is extended above and below sufficiently to provide for the easy introduction of a finger and later of the large Marion drainage tube. By syphoning the fluid out before making the incision a relatively dry operative field is obtained instead of the sloppy one usually encountered in cystotomy.

8 Through the bladder wound the offending prostate is felt the catheter is recognized and indicates the exact location of the inner urethral orifice and the presence or absence of a foreign body is determined. The catheter is then removed being no longer of use.

9 The Marion tube containing a perforated stopper and catheter is now inserted into the bladder. The three fixation sutures previously placed are tied drawing the bladder firmly against the abdominal wall as before described and obliterating spaces for seepage. The long ends of these sutures may be tied about the Marion tube for anchorage. The remainder of the wound is brought together the muscle layers with catgut the skin with silk worm gut. It is often advisable to place a small cigarette drain in the lower angle to drain the prevesical space. Dress and return to bed.

10 For effecting continuous drainage a rubber tube is attached to the Marion tube catheter intermittent suction being added by means of a Bremerman apparatus or some similar appliance. The patient is made to change position occasionally from his back to either side and liquid or light nourishment are given from the beginning there being no shock or alimentary disturbance to deal with.

Any undue amount of pain is controlled with codeine or morphine and continuation of the proctoclysis six hours daily is wonderfully efficient for promoting activity of the kidneys.

*Operative interval.* From the first to the second stage of the two stage procedure a

POLYPOSIS OF THE STOMACH<sup>1</sup>

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Fifth M. J. C.

THE benign tumors of the stomach, fibromata, myomata, and adenomata, because of their relatively low incidence, obscure symptomatology, and unknown etiology, have always been of great interest, particularly from a surgical standpoint. It was then with considerable satisfaction that we recently added to our collection of benign gastric tumors a perfect specimen of the rarest member of the group, a gastric polyposis. The fact that this is the first time the condition has been found in approximately 60,000 abdominal sections in the clinic, 8,000 of which were for gastric lesions, and that a correct diagnosis was established before operation is sufficient to make the case most unusual.

Case 250518, a married thirty-one year old male, came to the Clinic November 8, 1918, because of stomach trouble. A careful elicitation of the history disclosed relevant facts as follows. In 1910 the patient began to have periods of unexplained loss of appetite. During the following five years this periodic

anorexia was a great annoyance. The symptom which finally brought him to the Clinic was an empty stomach, first manifested itself in 1915. For a short time after its onset the pain showed some periodicity, but during the greater part of the three years it has occurred daily. The patient described the pain as a cramp beginning in the right and in the left hypochondrium and radiating toward the midline of the epigastrium. It was not associated with burning or with the usual subjective symptoms of hyperacidity, although it occurred only when the stomach was empty. He further stated that the stomach seemed to empty very rapidly and that the period of freedom from cramps after the ingestion of food had become increasingly shorter. By frequent eating he had kept his distress at a minimum and his nutrition was practically normal. There had been no nausea or vomiting or evidence of gastric bleeding. The patient had been discharged from the army in 1917, on a diagnosis of pulmonary tuberculosis, and after five weeks in a sanitarium home treatment was maintained until June, 1918.

The physical examination did not disclose any abnormal findings. There were no evidences of pulmonary lesion either clinically or by X-ray, and the Wassermann test was negative. The test meal showed an absence of free hydrochloric acid and the presence of a considerable quantity of epithelium. This achylia explained in a measure the symptoms of which the patient complained and considered with the character of the gastric pain and the fact that it had been continuous over a period of almost three years, practically excluded gastric or duodenal ulcer. The only clue which led to preoperative diagnosis was secured by X-ray examination. The entire pyloric end of the stomach exhibited a diffuse, mottled appearance, apparently well demarcated both at the pylorus and at a line about 4 inches

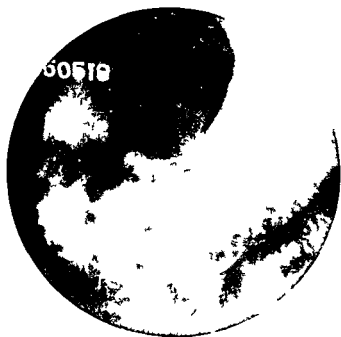


Fig. 11 (250518) The roentgenogram of the stomach. The mottled appearance is due to the presence of the gastric polyposis.



Fig. 12 (250518) The specimen of the gastric polyposis.

Received for publication September 15, 1919. Accepted for publication December 1, 1919.



on the intestines avoiding stagnation and flatulence. These three functions of the kidneys, heart and alimentary tract are of supreme importance in the next three or four days. If they are kept intact there is little likelihood of anything going wrong.

The patient should be encouraged to take fluids as soon as the stomach is settled and to turn on either side as well as on the back.

Sedatives are indicated if the patient is in pain or unable to sleep. Veronal and trional 5 grains each at bed time for the latter.

The Marion tube having performed its office of protection against clot formation is removed in the first 24 hours being replaced with a smaller elbow tube or large catheter or if conditions seem especially favorable dependence may be placed for drainage on the catheter that was tied in the urethra after the operation. Closure of the bladder wound may be expedited by tying at this time (second or third postoperative day) the sutures attached to each side of the bladder wound and left long for that purpose.

Naturally one must use judgment in adopting one course or another always acting on the safety first policy with regard to drainage and possible infection. Without free and adequate drainage complications are sure to arise. To secure this free drainage some surgeons go to the length of leaving the suprapubic wound wide open and without a tube of any sort the urine seeping up into thick pads of absorbent cotton that obviously require frequent changing.

This seems to the writer a most miserable and unwholesome plan and as unnecessary as it is unattractive. As a matter of fact a mild degree of infection nearly always occurs in that portion of the wound through which drainage is maintained but with the protecting measures fully carried out as described it is practically never serious and should not retard the closure of the wound which should occur in from two to three weeks. During this time the urethral catheter is used for continuous drainage. Being already in place the evils of attempting to introduce it under adverse conditions (through a disorganized prostatic urethra etc.) are avoided and its cleansing is easily accomplished by drawing it up through the wound by means of the thread previously mentioned. This gives complete control and without any disturbance. After a week or ten days when the wound becomes small the thread is cut off and the catheter is still retained this time by means of adhesive strips on the penis.

The patient is permitted to sit up in bed about the fourth day after either the first or second stage of operating but nothing is to be gained in having him get out of bed at this early period as has been claimed by some operators.

Within 24 hours after operation it is found useful to add one or two grains of calomel in half grain doses to the pepsin followed a few hours later by a mild saline laxative. After this a daily dose of one of the neutral oils is serviceable.

corresponds with the generally accepted view. The patient made a very satisfactory recovery and returned to his home December 16, 1918.

From a study of this case in conjunction with such cases described in the literature it would appear that gastric polyposis has sufficient characteristics to be classified as a separate entity and should not be confused with single polyps or papillomatous masses (the latter usually malignant) occasionally found in the stomach and to which the term gastric polyposis has at times erroneously been applied. No positive etiologic factors are known and elaborate investigations in our own case both before and after operation failed to reveal any clue. It should be emphasized in this instance that the condition would have been quite unsuspected had it not been for the roentgenograph and its

interpretation. It is also of interest that in the only other similar case described in this country—that of Myer—a preoperative X-ray diagnosis was made by Carman. The age of the patient, 31 years, is unique because it is the earliest age at which the condition has been recognized. The accurate and early diagnosis leading to the correct indications for treatment is an excellent illustration of the advanced methods of diagnosis available to the clinician of today.

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## THE ROLE OF THE CYSTIC DUCT IN RECURRING CHOLECYSTITIS

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**C**LINICALLY the pathologic processes involving the cystic duct which serve as factors in recurring cholecystitis may be divided into first, those that interfere with the lumen of the duct and thus cause stagnation in the gall bladder making it a good incubator in which bacteria may grow, and second, those that harbor infective organisms which may pass up into the gall bladder with the bile as it flows upward.

Before taking up a discussion of the pathologic processes it is best to review briefly the anatomy and physiology. The cystic duct is about 3.7 centimeters in length and averages about 3 millimeters in diameter. It leaves the gall bladder with somewhat of an S-shaped curve and passes downward and inward between the layers of the lesser omentum to unite with the hepatic duct to form the common duct. It has three coats which are from within outward mucosa, muscularis and fibrosa.

The mucous membrane is continuous with that of the gall bladder and like that is lined with columnar epithelium. Mucous glands are found beginning on the surface of the mucosa and extending through into the deeper layers. The glands consist of a straight portion lined with columnar epithelium (Fig. 1) and a coiled portion in which the cells may approach the cuboidal (Fig. 2).

A series of valves known as the valves of Heister are alternately arranged along the entire length of the duct (Fig. 3). The valves are crescentic in shape and extend transversely. At the upper end they are thicker, closer together and project well into the lumen. They gradually diminish in size, become farther apart and irregular in distribution as the lower end of the duct is approached. In the center of the valves are found connective tissue and muscle fibers. They are covered with mucous membrane like the remainder of the duct.

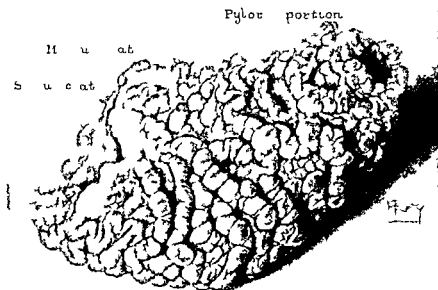


Fig. 3. D. K. F. I. J. with tumor of stomach.

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Further study of the resected stomach revealed that it conformed to the type of poly-

poid which has been described by the French (McNetric) a *polypoides polypoides*. The fresh specimen exhibited no change except in the mucous membrane. No infiltration of the coats had taken place and the specimen could readily be turned inside out. The mucous membrane was highly congested and tumors of various size were distributed over the entire surface. The tumor were globular and were arranged noticeably in rows in the transverse axis of the stomach. The masses were in close apposition to each other as is shown in Mr. Fry's drawing (Fig. 3). The intervening mucous membrane between the rows showed a few much smaller isolated globular elevations (Fig. 2). The great majority of the elevations were of the size of a hazel nut and 50 of them could easily be counted individually. They were soft and velvety to the touch and gave no microscopic suggestion of malignancy or destruction of tissue. A section of the gastric wall containing a tumor examined microscopically showed the bulk of the tumor to be composed of a tremendously hypertrophied mucous membrane. No hyperplasia of glandular element was of a character to suggest malignancy. The pathologist believe the condition is not malignant. The



Fig. 4 Hypertrophic changes in the manner in which obstruction is produced

Fig. 5 Marked hypertrophy of the valve

Fig. 6 Villous growth on the valve

hyperplasia because it interferes with the lumen of the duct more or less. The hyperplasia may involve all of the valves or only a part of them (Fig. 4). The valves instead of being narrow projecting folds become broad blunt projecting masses which may lie so close together that when the circular fibers of the duct contract they are erected and thrown inward so that they may pass while the longitudinal fibers draw them together at their bases until they may nearly or entirely touch thus producing a partial or complete obstruction. In this manner a biliary colic may be produced that is identical clinically with that produced by gall stones. Sometimes but a single valve is enlarged in which case the hypertrophy may be more marked (Fig. 5). Occasionally they are larger than the lumen of the duct and as viewed by the microscope are bent upon themselves so as to extend lengthwise of the duct usually pointing downward. When there is marked hypertrophy contraction of the circular fibers down upon the valve will completely occlude the duct.

Histologically the hyperplasia is due mainly to connective tissue increase although some times there is hyperplasia of the muscle fibers as well. I have seen dilated mucous gland in some of the enlarged valves although I have never seen glands in normal valves.

3. *Ulcers*—Ulcers are the result of pressure from stones, the action of infective organisms within the duct or the toxin of such organisms and infection within the walls of the duct with lodging of the infected area into the lumen. Some ulcer how considerable in

duration. Interference with the lumen comes through induration and muscle spasm.

4. *Carcinoma*—I have never observed a primary carcinoma of the duct.

#### B. Intramural lesions

##### 1. *Strictures may be congenital or acquired*

The acquired usually follow injury from gall stones, the healing of ulcers or intramural infection.

—*Localized infection* may be due to organisms coming through the blood stream, extension into the mucous glands or by direct extension from within or without.

##### 3. *Cysts or other enlargements of the mucous glands*

4. *Hyperplasia* (a) Hyperplasia of the muscle is usually the result of a partial obstruction of the cystic or common ducts. (b) Connective tissue hyperplasia is usually preceded and accompanied by a chronic infective process.

5. *Edema* of the cystic duct may be a part of a general edematous process, a part of an edema involving the gall bladder and ducts or the cystic duct alone or a portion of it may be involved in which case it is usually the result of an infection, foreign bodies within the duct or other irritating processes.

##### 6. *Tumors*

##### C. Extrinsic

1. *Angulations* due to adhesions, constricting bands or displacement of the duct.

Pressure from tumors, enlarged gland inflammatory or similar lesions.

#### II. Processes which harbor infection

##### Intrinsic



Fig. 1. St. 1. ht. 1. t. f. I. k. C. l. i. p. t. f. m. F. 3. H. t. p. e. h.  
 1. th. l. m. 1. l. l. 1. th. f. l. l. p. th. l. m. m. r. l. h. p. e. t. p. h. y. h.

except mucous glands are not present. Moynihan states that the valves are folds of mucosa but this is in error for muscular fibers from the muscularis enter the valve.

The muscular coat is made up of circular longitudinal and diagonal fibers of which the circular predominate. The amount of muscle is greatest near the gall bladder whence it gradually decreases there being the least near the juncture with the hepatic duct. The circular fiber extends into the heisterian valve and also the end of some of the longitudinal fibers so that when the muscle of the duct contracts the folds become erect and are drawn closer together thus interfering with the size of the lumen by narrowing it and also by drawing the valves nearer each other. In pathologically enlarged valve the lumen may be entirely closed by the mere contracting of the longitudinal fibers bringing the valves together. The diagonal fibers do not enter into the formation of the valve.

The fibrous layer is made up of connective tissue loosely connected with that of the lesser omentum.

The function of the cystic duct is not merely that of a tube connecting the gall bladder with the other duct but through the valve and its muscle the flow in and out of the gall bladder is regulated to a certain extent and through the peristaltic muscular contraction the duct has expulsive power.

#### PATHOLOGY

Only a brief resume of the pathology will be given the lesion will be considered according to the following outline.

#### I Obstruction partial or complete

- A Intrinsic or those which lie in the lumen or extend into it
- B Intramural or those which involve the wall of the duct
- C Extrinsic or those which lie outside of the duct and produce obstruction by pressure or by angulation through pulling the duct out of its normal position

#### II The processes which harbor infection are classified as

- A Intrinsic or those in which the organisms grow within the lumen
- B Intramural or those processes in which the organisms are harbored within the wall of the duct and thence discharged into the lumen

#### 1 Obstruction 1 Intrinsic

a Foreign bodies (all stones are the most frequent. Plugs of mucus sometime obstruct although probably not so frequently as was formerly supposed. Worm and echinococcus cysts have been reported as found in the cystic duct.

*Pathology of the heisterian valves* While undoubtedly other processes occur up to the present I have observed only three namely acute inflammation and chronic hyperplasia. The adenoma here referred to was a part of a general adenomatous condition involving the remainder of the duct as well. The acute inflammation was a part of a general process involving the entire duct and gall bladder showing nothing characteristic in the valve.

The most important lesion is chronic

g Adenoma I have seen marked hypertrophy of the glands but none to such an extent that the term adenoma could be applied to it yet I believe it is possible that they do occur (Fig 10)

h Primary carcinoma I have not observed any up to the present

#### CLINICAL SIGNIFICANCE

Clinically the obstructive lesions can best be classified according as they produce permanent complete obstruction transitory complete obstruction permanent partial obstruction or transitory partial obstruction

In the obstructions the involvement of the gall bladder may completely overshadow the cystic duct clinically The following conditions have been observed as the result of such obstruction acute and chronic cholecystitis hydrops empyema sclerosis and calcification The latter two occur only with the permanent complete obstruction while the former three occur with any form of obstruction but more often probably with the transitory types especially those resulting from foreign bodies

Excluding the symptoms that come from the gall bladder involvement with permanent complete obstruction pain may be entirely absent and when present is usually dull and never colic like Tenderness is present

The transitory complete obstruction on the other hand is usually accompanied by pain which may be colic like at first but if the condition persists without an occasional remission or when due to a stone and the stone does not pass on downward or becomes loosened the pain soon loses its colic like character Infection is very frequently present

Permanent partial obstruction is accompanied with tenderness and pain of a more or less dull character There may be occasional attacks of colic like pain Hypertrophy of the muscle of the duct above the obstruction and of the gall bladder occurs

In transitory partial obstruction there is tenderness present and pain varying with the degree of obstruction When the lumen is markedly encroached upon there may be a colic that cannot be distinguished from gall stone colic regardless of what may be the cause It is produced by the intense muscular contractions that are attempting to force the contents of the duct or gall bladder or both by the obstruction This condition is often accompanied by more or less infection

Obstructive lesions by forming pockets or otherwise causing retention harbor infective organisms and thus predispose to infection of the rest of the biliary tract or through the blood stream elsewhere in the body

The glands of the cystic duct become of importance clinically first when they become infected (a) By discharging organisms into the duct which may pass upward with the bile into the gall bladder or downward into the common duct whence they may ascend to the liver

b By acting as a focus whence organisms may go into the blood stream

c By perforation into the lesser omentum or peritoneal cavity and thus there may result an abscess in the former case or a peritonitis local or general in the latter

d Through the action of the toxin absorbed

Second when they become distended and encroach upon the lumen of the duct

The positive diagnosis of lesions of the cystic duct will rarely be made clinically or with the exception of stones or other masses upon gross examination In the majority of cases the microscope will be required

The clinical indications are for cholecystectomy Drainage will relieve secondary lesions but it would not have any influence upon permanent strictures could not guarantee that transitory strictures might not return and in the case of infected glands there would be but little influence upon the deeper portions



Fig. 1. Fig. 2.

Fig. 1. Ductal crypts, Fig. 2. Intra-mural abscesses.

Fig. 3. Fig. 4.

Fig. 3. Chronic infection, Fig. 4. Perforation.

1. Forcible duct by interfering with the lumen lowering the resistance through pressure and the formation of pocket which holds bile and the secretion of the mucosa irritates and predisposes to bacterial growth.

Obstructive lesions through producing a cystic pre-disposition only to bacterial growth but also to the extension of the bacteria to the gall bladder.

3. Villous growth. The mucosa of the cystic duct like that of the gall bladder has a predisposition to a fine villous growth in the presence of chronic irritation. The villi have a delicate connective tissue framework containing tiny blood vessels and are covered with columnar epithelium. They do not grow as large as those in the gall bladder are not so numerous and do not anastomose so freely. They are not large enough to interfere with the lumen but may harbor bacteria (Fig. 6).

4. Ulcer when present are a continuous source of infection.

#### I. Intramural

1. The lesions of the mucous gland are the most important lesions in this class. They do not differ materially from those of the mucous gland of the gall bladder except that bile pigment so far as I have been able to observe is never found in them. The principal lesions are:

a. Simple infections within the gland. The lumen becomes distended with an accumulation of de-quartered epithelium, pus cells, bacteria and mucus.

b. Periglindulitis. This is an advanced stage of the former and in addition to the above finding there is a round cell infiltration around and congestion about the glands.

c. Intramural abscess. In the presence of intense infection or when there is not free drainage in milder infection breaking down and abscess formation may occur. They may be single or multiple. After abscess formation has taken place the duct of the gland may open and the abscess discharge into the lumen of the cystic duct. The abscess may rupture either externally or internally or the process may go on to resolution.

d. Perforation as mentioned above may take place either into the duct or into the lesser omentum or into the peritoneal cavity.

e. Chronic infection. The gland becomes more or less distended with detached and broken down epithelium, pus cells, bacteria and mucus. About the duct is a round cell infiltration. The duct may remain open or open intermittently discharging its contents including bacteria into the cystic duct. If case the duct become permanently closed it may heal the infection may become latent in intramural abscesses may develop or there may be distention due to retained secretion.

f. Intramural cyst. Distention of the gland may occasionally be due to back pressure but it is usually the result of the obstruction of the duct with the retention of the secretion. For otherwise bile pigment would be found in the cyst (Figs. 7, 8 and 9).

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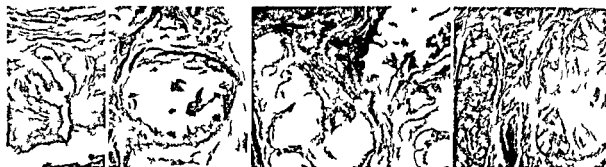


Fig. 8. Duct of the gill bladder. The duct is lined by a simple cuboidal epithelium. The lumen is filled with mucus. (H. & E., 100x)

Fig. 9. Duct of the gill bladder. The duct is lined by a simple cuboidal epithelium. The lumen is filled with mucus. (H. & E., 100x)

1. Foreign body interfering with the lumen lowering the resistance through pressure or the formation of pocket which hold bile or the secretion of the mucous gland predispose to bacterial growth.

Obstructive lesion through producing a tumor predispose not only to bacterial growth but also to the extension of the bacteria to the gall bladder.

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irritation is in the vicinity of the pylorus or gall bladder we find Mayo Robson's tender point relating to the first sympathetic lumbar ganglion on the right side. When the sympathetic lumbar ganglia of both right and left sides are found to be tender on pressure we may look to the pelvis for the source of

irritation. The pelvic ganglia receive and distribute impulses over such a large area that a chronic source of disturbance in the pelvis seems to be registered upon both right and left sympathetic lumbar ganglia instead of on the ganglionic point on the right side belonging to the appendix.

## CONGENITAL DIVERTICULA OF THE INTESTINES

REPORT OF A CASE OF A TUMOR GROWING FROM THE TIP OF AN APPARENTLY CONGENITAL DIVERTICULUM IN THE LOWER SIGMOID REGION<sup>1</sup>

By WILLIAM T. BLACK, M.D., F.A.C.S., MEMPHIS, TENNESSEE

THE vitelline duct which is attached to the ileum should disappear between the sixth and seventh weeks of intra-uterine life. At this time it should change from a tube to a cord which in turn melts away leaving the bowels free from their connection to the umbilicus. When the cord remains we have a diverticulum. Diverticula are either congenital or acquired. This paper deals only with the congenital or inherited type. A true diverticulum is the remains of the vitelline or omphalomesenteric duct that is its intra-abdominal portion. Lavata in 1671 was probably the first to call attention to the diverticulum and later Ruysch described it more accurately. It remained for Meckel by whose name the diverticulum is named to give to the world its true pathological and surgical significance. The acquired types have assumed their importance both from a pathological and a surgical viewpoint and have been elaborated upon by many able writers and will not be discussed in this report. Meckel's diverticulum is estimated to be present in about 1 per cent of people. It varies in length from 1 to 10 centimeters and may be found from 30 to 90 centimeters (the average distance being 100 centimeters) above the ileocecal valve (in the child the distance is less) where the yolk stalk is attached. In cases where the lower limb of the primitive intestinal loop has undergone excessive development it may be found in the

cæcum or colon.<sup>1</sup> At times it remains patent throughout and there may be present fecal matter exuding from the umbilicus or it may be closed on the intestinal side and open at the umbilicus but usually however the distal end is closed and the proximal end open. It varies in size from a very small cord like structure to one as large or even larger than the lumen of the gut. There may be smaller false diverticula connected with a true diverticulum. It may be bulbous at its distal extremity and narrow at its intestinal end.

Both extremities may be occluded and patulous in the center. Sometimes there remains only a fibrous cord and at times only blood vessels. It usually arises from the convex side of the gut but may spring from the mesenteric side and may have a mesentery of its own. Wellington says that in about one third of the cases it is attached to the umbilicus or adherent to some other part of the anatomy.

A pre-operative diagnosis of the presence of a diverticulum cannot be positively made. A probable diagnosis may be made in those with a fecal discharge at the umbilicus. A discharge of any kind at the umbilicus with a sinus or a growth present is suggestive. Especially is this true in children where the child is afflicted with gastro-intestinal symptoms. Right-sided abdominal pain which continues or follows the removal of the appendix after a

Bull. se. chir. 97

R. ad bel. reth. S. thern. S. gical. Asso. latio. B. l. m. re. Decembe. 7. 9. 9. 8.

## NOTES ON TWO SIGNS IN CHRONIC APPENDICITIS

BY ROBERT T. MORRIS, M.D., IACSON, N. Y.

ONE of the most frequent visitors to the doctor's office is the patient with indefinite pain of transitory character belonging to the right side of the abdomen. If the patient consults the surgeon the latter is prone to find symptoms of chronic appendicitis and he sometimes alarm the patient with a prognosis of impending disaster if the appendix is not removed. When this same patient enters the office of the internist with the appendix in the form of a question mark the internist is prone to treat the matter lightly and to say that the pain is caused by gas in the cecum in the ascending colon a condition which is recognized readily on percussion of the abdominal wall. The greater number of these patients belong to the neurasthenic group patients with stigmata of decline presenting objective signs in stigmata of arrested development of various structures of the body. The appendix vermiformis as a vestigial structure with a tendency to undergo involution changes of its various coats appears to undergo involution earlier in patients of the neurotic group. Involution changes which normally might become marked in the average individual at perhaps fifty years of age may appear in the patient with stigmata of decline at the twenty-fifth year of age. The appendix undergoing involution change with connective tissue replacement of its coats becomes a source of irritation to the ganglia of the autonomic and sympathetic nervous system. Nerve elements remain in such an appendix until practically all other structures have disappeared and the nerve elements are irritated by the contracting of hyperplastic connective tissue. Irritation calls for a special determination of blood supply to that point and the control of the blood supply belong in the domain of sympathetic nerve function. When the message from the irritated appendix is registered for a sufficiently long time upon the ganglia relating to the cecum and the ascending colon the muscular coats of the cecum and the ascending colon eventually

become exhausted. This part of the bowel then becomes more or less permanently distended with gas and gives us an important differential diagnostic sign belonging to chronic appendicitis but not to acute appendicitis. I call it the cider barrel sign for the purpose of making a picture because percussion upon the normal left side of the abdomen elicits a note suggestive of a cider barrel in October while percussion over the distended bowel on the right side brings out a note suggestive of the cider barrel in March.

Another sign belonging to chronic appendicitis and not to acute appendicitis relates also to sympathetic nerve ganglia apparently due to persistent registering of impulses. It is not unlikely that the impulse extends in an afferent way to a segment of the spinal cord and then proceeds efferently to one ganglionic point and at the same time to the kin in the zone described by Head as belonging to the appendix. The ganglionic point apparently relates to what anatomists sometimes now speak of as the fused ganglion consisting of the second and third right lumbar sympathetic ganglia. Hyperesthesia of the fused ganglion will be in evidence if we make pressure deeply and slowly upon the patient's abdominal wall about an inch and a half to the right of the navel and a trifle caudad. When we find this tender point distinctly in evidence and standing alone without tenderness of the left lumbar ganglia there appears to be definite evidence that we are dealing with the appendix as the source of trouble.

Chronic appendicitis relates most frequently to an irritative lesion rather than to an infective lesion. It belongs most often to that irritation of nerve element by the contracting connective tissue which belongs to involution change. The irritative feature however may belong to ordinary scar tissue which has followed an infective involution of the appendix. In chronic appendicitis cause the two signs here described appear to have distinct diagnostic value. When the source of the

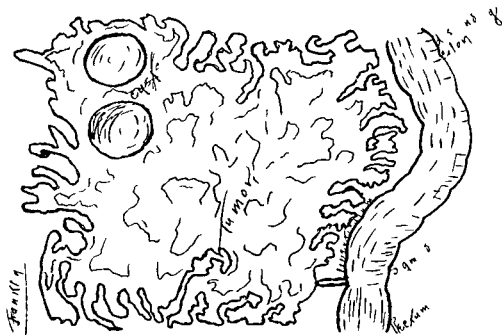


Fig Rough sketch showing attachment of tumor to diverticulum

and about the size of the little finger. The diverticulum was caught with two clamps and cut. A probe was pushed through the diverticulum to the gut to confirm its character. A purse string suture was passed around the gut end and the stump was treated as the stump of an appendix is usually treated. I was surprised to find such an origin as I expected to find the origin of the tumor coming either from the ovary or the uterus. There was not an adhesion to any abdominal or pelvic structure except where the cyst was attached. The uterus and appendages were normal. This mass had every appearance of springing from only the endothelial side of the intestine (diverticulum). I noticed particularly the absence of large blood vessels running through the diverticulum as one would expect to find in so large a tumor. There was a small mass in the hilum of the spleen. There was no evidence of metastasis in any other organ.

The following is the pathological report on the specimen sent by Dr H. T. Brooks, professor of pathology at the University of Tennessee:

The specimen is a whole which would probably fill one and one half to two gallon bucket. The external surface showed many small and a few large papillary projections. Here and there were large and small fluctuating masses indicating the presence of cysts. Everywhere the tumor had a markedly gelatinous appearance. Sections through the tumor showed cysts of varying sizes, one holding a pint or more of fluid. The fluid is brownish in color. The contents of the cyst showed no mucin.

Microscopical examination of the six different areas of the tumor showed several layers of epithe-

lial cells with no indication of downgrowth into the stroma. The several layers of cells however point to a malignancy. The stroma everywhere showed extensive myxomatous changes and this accounts for the gelatinous appearance of the tumor. (It was my impression at first sight of gross inspection that it was due to a mucous degeneration on the part of the epithelial cells. This however was incorrect.)

Diagnosis malignant cystadenoma, the stroma of which has undergone an extensive myxomatous change.

The following is the report from the Pathological Laboratory of Dr William Krauss, Memphis, Tennessee:

*First report.* Examination of specimen submitted shows bad fixation. Such tissue is apt to be autolytic and consequently indistinct. Two areas have been picked out. The most developed cells have the characteristics of the fibroblasts from endothelium. The younger ones sometimes in islands are normal and rather small but evidently purely endothelial cell. The stroma is myxoid. I regard it as myxoma springing from the serosa and preserving some of the characteristics of endothelial origin. This report was based on small sections of tumor sent to him.

*Second report.* The following is the report upon the tumor mass submitted to me after I had reported on the sections made from smaller pieces.

The entire mass impregnated with formaldehyde weighed 140 grams about three pounds. It is bluish white in color translucent very lobulated with numerous fine cauliflower exuberances. Many of the warty masses are cystic. Some of the cysts are imperfectly formed the tissues gradually merging into a mucous material. The larger older cysts

careful inspection of other organs which are found to be normal is suggestive to a certain extent (if adhesions can be ruled out) of a diseased diverticulum. The X-ray may assist in a pre operative diagnosis.

Mumford estimates that 13 per cent of the diverticula become inflamed or diseased. The principal danger then lies in the 13 per cent of cases for we all know the frequent occurrence of intestinal obstruction produced by a diverticulum. In 2 cases at the St Thomas Hospital from 1887 to 1908 63 or 6 per cent died—a mortality of 1 per cent higher than that from all other sources (including cancer). Hilgenrainer's report of 10 collected cases in 1900 shows a mortality of 71.5 per cent. Murphy stated that 5 or 6 per cent of intestinal obstructions were due to diverticula. The majority of people who possess diverticula are without symptoms. Diseased diverticula will produce symptoms in proportion to the extent of the pathology present. Symptoms simulating an acute or chronic appendix may be present. The symptoms of obstruction or symptoms due to growths which spring from them give the usual symptoms of such conditions.

The following patient came under my care at the Baptist Memorial Hospital in October 1918.

Mrs. Mary S. age 59, white female American, did housework and worked in the field. Her family history is negative. She denies previous history of syphilis, cancer, tuberculosis, insanity, etc. She had the usual diseases of childhood. The patient married at the age of 4. Her physical and mental appearance is fair. The patient began four years ago to have pain in right iliac region, sharp and shooting in character. This was not accompanied by any gastro-intestinal disturbances. The pain subsided in about three weeks. Some time later she developed a lump in her abdomen which was movable but not accompanied by pain. The tumor did not disturb the patient in any way, causing only slight discomfort and constipation. The abdomen commenced to enlarge about 20 years ago and has continued to enlarge ever since. The abdomen was large to the left side. The tumor seemed to stay the same size for 12 or 15 months then began to enlarge rapidly with symptoms of bearing down pain, constipation and backache, dyspnea, etc.

The patient first menstruated at 4 years regular, 28 days type, 4 or 5 days duration, quantity of flow normal. The menopause occurred at the age of 5.

The patient is the mother of eight children, the

oldest 44 years old, the youngest 17. Her labors were normal. She was not attended by a physician during any of her labors. She had one premature labor at eight months. No complication or sequelae followed any of her confinements. She has no leucorrhoea, she has constipated micturition has been frequent for past few months. She suffers from indigestion, flatulence. Nervous symptoms are negative. Previous treatment—medical.

Physical examination shows a well developed, poorly nourished woman. She has lost several pounds in eight months during the past few months. The skin is sunken and wrinkled. The eyes are normal, the teeth bad and the breath foul.

Thoracic cavity negative. Blood pressure systolic 15, diastolic 10. The abdomen is distended to about the size of a nine months pregnancy. A tumor half an inch irregular in outline is cephalic on the upper right side, fluctuates on palpation. Flatness is normal over the entire abdomen except that a tympanic note is present over the colon. There is no rectal tenderness. The spleen and kidneys are not palpable. The liver is normal. Except for slight emaciation, the external features are normal. Laboratory negative.

Blood count: leucocytes 6800, reds 4048, 0 polymorphonuclears, 80 per cent, small lymphocytes 15 per cent, large lymphocytes 4 per cent, eosinophils 1 per cent.

Wassermann test negative.

General appearance of vulva is normal. There is a slight leucorrhoeal discharge. The perineum is negative. The cervix is pushed up under the pubic region. The uterus is pushed forward. The pendulages are not palpable. A large mass is present.

A preoperative diagnosis of either a large subserous myomata with cystic degeneration or an ovarian tumor was made. The patient was operated upon on October 4, 1918, under ether anesthesia. A median abdominal incision was made from the pubes, extending up nearly to the xiphoid cartilage. A large, irregular, cauliflower shaped tumor filled the entire pelvic and abdominal cavities as far as could be seen. The tumor showed marked cystic degeneration. No free abdominal fluid was present. Weight of tumor 460 grams.

There were two large cysts at the upper right portion each about the size of a large grapefruit, filled with chocolate colored fluid. The tumor was entirely free from the rectum, the uterus, the ovaries except at its origin. Here it was placed in a cyst as described to the anterior abdominal parietal peritoneum just below and to the right of the umbilicus. The adherence of the cyst to the peritoneum was loose and the mass lifted out of the abdominal cavity. The origin of the tumor sprang from the tip end of a diverticulum. The diverticulum had its orifice in the lower portion of the sigmoid (rectosigmoid region). It sprang from the mesenteric side of the gut. The mesentery on the diverticulum was about 11 centimeters in length.

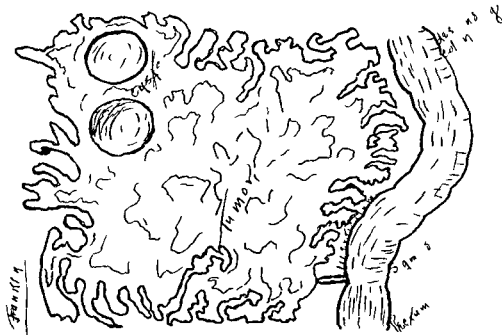


Fig. 1. Rough sketch showing attachment of tumor to pericolicum.

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fe p lce Tl tr n the o ly act e tissue  
and th ffo d upply is exc d nly c nty

D g s l b muc s peiton a poly p Al  
though th gro r emblinc to n o a a tun o  
is st k g the e th in th h i tol j to su  
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(The b e e spec tunc l by Dr  
Will an kraus fr m lout th l f the t  
h h e t to tim)

The following report was given by Dr W  
G MacCallum of the John Hopkins Uni  
versity

Th j i n apy r t t l p plomat us  
g tl mp ed f v lo e and l matou  
stom atter more den n r the f ce d  
t rming l rke r und p pl v mas e It is in pro  
tectel plac s cov cl ith a lav r of epithel um  
hich i n places cyl ncl cl ith gh usually  
cub l ftt ned In e josed places th p the  
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stom app ar a though the b ement meml ran  
h d b l fte l off by a flu l

Thre as a all on loth side of l l the  
papillary mas seemed to p j t b t the sections  
do not h th p o lly those cut deeper in the  
block ll to so l enclo e thr s ct ons

From the above reports the tumor is  
evidently potentially a malignant type The  
tumor was in the stage of regression which  
probably was due to a poor blood supply  
There were no vessel of any size in the  
diverticulum and the growth probably re  
ceived its principal sustenance from the perito  
neal fluid Unless the small mass in the hilum  
of the spleen was a coincidence then one  
would naturally think the tumor was a  
malignant one and thus a metastatic growth  
I am unable to account for such a mass as  
thu growing from only the outer coat of the  
diverticulum If it was a malignant tumor  
I am unable to find an exciting cause It is  
improbable to suppo e that peristalsis or the  
movements of the other v i cera could produce  
any irritation It is possible that when the  
patient had the severe pain in her abdomen

four years ago she had a diverticulitis or  
that in ulceration might have been produced  
from within which extended to the outer  
portion of the diverticulum or what probably  
occurred was a perforation The formation  
of a malignant growth can at times be  
accounted for by the retention of hardened  
fecal matter or concretions acting as a predis  
posing or exciting cause The retention of dry  
fecal matter or foreign bodies in the location  
is favored by a constriction at the si moid  
rectal portion We have in the lower sigmoid  
in the embryological stage a dilated or pouch  
like condition present This dilatation may  
continue in the adult as an embryonal defect  
which might further assist in the retention of  
fecal matter This dilatation might have  
been the source of the diverticulum Stric  
tures or growths of the rectum hemorrhoid  
or any inflammatory process involving the  
rectum would naturally resist the proper  
expul sion of the intestinal contents Too long  
retention of this fecal matter or concretions  
might in a certain percentage of cases produce  
an ero ion or ulceration which might act as a  
starting point of a precancerous lesion The  
same might apply to a diverticulum in this  
region

In the ca e reported however there was  
no hardened fecal matter or foreign bodies  
pre ent and the diverticulum and si moid  
were macroscopically normal everywhere  
(except at the attachment of the growth)  
The principal etiological factors can best be  
explained through an embryological condi  
tion or foetal rest or transplantation of tissue  
from some other organ or started as an in  
flammatory process I am unable to find in  
the literature at my disposal a description  
of a similar case Doubtless however other  
cases have been observed and recorded of a  
like character A congenital diverticulum i  
unusual in this portion of the gut and can  
only be accounted for through an error in  
embryological development

Bize in 1904 Deve in 1906 Denun in  
1908 report cases of small pancreatic tissues  
growing from the tip end of Meckel's diver  
ticulum Colmers in 1906 published an article  
upon intestinal cysts and their treatment  
He says Raesfeld was the first to describ

an enterocystoma and that he drew attention to the fact that it developed from a Meckel's diverticulum — (Cullen)

Cullen, Cowardine, Rimbach, Roth, Tide, man, Colmers and others have reported cystic tumors connected with the remains of the omphalomesenteric structure. In Kimblich's case the tumor was as large as a man's head and adherent to the omentum.

Most of the reported cases have been small tumors usually cystic and connected with Meckel's diverticulum in the iliac portion of the intestinal tract or at the umbilicus. Mayo reports the rupture of a sigmoid diverticulum which was thought to be congenital in type forming an abscess in the pelvis. Cases of carcinoma are reported where a diverticulum is involved secondarily by contiguity of tissue. The treatment of an inherited diverticulum depends upon whether the organ is diseased upon its location and upon its structure and size. All diseased diverticula when attached to some other structure at its distal end should be removed. Those with small proximal openings and all found in the large gut (where solid feces are found) should be removed. When the vitelline duct remains as a cord or set of blood vessels it should be excised. Large normal diverticula discovered accidentally in the small intestine (where we have only liquid feces) should be left alone for the fear of increasing mortality.

#### CONCLUSION

This tumor was connected only to the serosa side of the diverticulum. Potentially it was a malignant growth. A diverticulitis or perforation could be assigned as a predisposing or exciting cause although it could be attributed to a fecal inclusion. This diverticulum had the characteristics of a congenital type but it is possible for it to be of the acquired type. Unless one can palpate the uterus and ovaries a differential diagnosis cannot be made between a uterine myoma with a pedicle or an ovarian tumor and a tumor growing from a diverticulum in the lower sigmoid region.

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## WAR AMPUTATIONS

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THE Interallied Surgical Conference at its meeting in 1917 came to the following conclusions in regard to the subject of amputations:

Primary amputations (or those delayed 4 or 48 hours) will be made as nearly as possible at the site of fracture by simple section of the soft parts or with slight trimming of the bone in less grave cases the amputation will be made as near as possible to the level of the fracture.

Amputation for infection will be made by simple cross section or with very short flaps fixed in elevation. The stump will be regularized if this is necessary when the wound is disinfected and when all possible extension of the soft parts has been obtained.

The technique in cases of retarded amputation will be governed chiefly by the indications of prosthesis.

In cases of fissured fractures extending very high the fissured fragment may be preserved but disinfection of the wound must be practiced.

For years the dominating idea in determining the surgical procedure of amputations has been to obtain a stump able to bear weight upon its end. The various osteoplastic methods which have been introduced are witness to this fact. Surgeons generally have had the impression that no satisfactory prosthesis could be applied for example to the leg in the absence of the ability of that stump to bear pressure upon its end. This impression is erroneous. Up to the present end weight bearing ability when present except in the comparatively rare cases of Syme's amputations and disarticulations of the knee or hip has been almost altogether disregarded by artificial limb manufacturers. In cases of thigh amputation the principal support is taken upon the tuberosity of the ischium with secondary support upon the soft parts of the stump in amputations below the knee upon the shelving under surface of

the plateau of the tibia. Cases provided with apparatus in this manner walk extremely well without any bearing whatever upon the end of the stump.

This does not mean to say that end weight bearing is not desirable. It should be developed and used whenever possible. The work of Hirsch and Lisle has shown that this ability is largely a matter of treatment and that it can be developed in a large percentage of stump by the systematic use of end pressing exercises or end pounding during convalescence.

In general however successful end weight bearing demands certain qualities of the stump itself such as good covering for the end of the bone, mobile non-adherent flaps, absence of terminal scars and mobility of the scar. In order to obtain these infection and a septic healing are essential. In war wounds primary healing even when the amputation has been made well above the level of the lesion and the wound sutured is exceptional. Generally the stump becomes badly infected or distended with gas and opening of the flaps or reamputation becomes necessary. In this way the desired end has been defeated and yet there has been a needless sacrifice in the length of the stump.

A stump above all things a lever and its most important asset is length. Valuable as end bearing power may be when properly put to use it is small in importance when compared with length. As between the method of operation which will give to the patient the maximum length of stump and another which will shorten the bone in order to obtain end bearing at the most problematical the choice should go without doubt to the former.

The only way to judge amputation cases is by the result obtained when the stump is fitted with prosthetic appliances. From this standpoint there can be no question that the best results are secured in those cases where the operator abandons the classical method

and attempts to save the maximum length by section at the level of the wound while at the same time making provision for dealing with the omnipresent infection by leaving the wound wide open. The care of creating a sound useful stump is left to a secondary surgical intervention. Many of the resulting stumps fail to meet our old definitions of what constituted healthy stumps and some demand still further surgical treatment but as a whole the gain has been great because there has been a general saving in length. Examination of three hundred amputated French soldiers six months or more after healing of their wound showed only 6 per cent with what might be considered as classical stumps. Seventy per cent had terminal scars which were adherent to the bone in 50 per cent. The end of the bone was protruding under the skin in 20 per cent. Practically all of these cases were wearing artificial limbs usually of a poor type and in spite of it they uniformly walked well.

The tendency of distinguished allied surgeons during the past year has been more and more in the direction of ceasing to regard amputations as a special group of cases requiring a special operative technique and instead to class them with all other war wounds and amenable to exactly the same rules of surgical procedure.

The limb is divided at the level of the lesion. The contused and injured or infected tissues are excised and when it is possible to obtain sound short flaps from in front of or behind the missile tract these are preserved but packed wide apart. Long flaps are usually dangerous as they tend to fall together despite care and interfere with drainage.

The treatment of the end of the bone is variable and depends upon conditions and the probability of remaining infection. Where it has been possible to do thorough excision of all damaged or infected tissue all projecting bone may be removed but when it is probable that infection will develop it is better to leave the bone long and postpone the shortening of it to the secondary operation. It is fairly certain that the apertosteal method of dealing with the end of the bone gives the best results. Formation of osteo-

phytes around the end of the bone in war amputation stumps has been extremely common. This is probably due in large measure to the shredding of the periosteum preparatory to sawing the bone. With care this may be prevented and with a curette the periosteum is removed on a surface of one quarter inch above the level of the section. Similarly the medulla of the bone should be curetted for about the same distance. In the absence of infection with this method the end of the bone becomes more or less absorbed and rounded and the formation of osteophytes is minimized.

The vessels should be ligated with as little dissection as possible. It does not matter if they project upon the surface of the wound. The treatment of the nerve ends demands special care. A good method is to draw down upon the nerve separate and peel back its sheath and divide it as high as possible by a wedge shaped or fish tailed incision. The end of the sheath is then drawn down and ligated. Formation of neuromata and painful nerve endings are avoided in a very large percentage of cases treated in this manner.

In a certain number of primary amputations the stumps so prepared may be closed by delayed primary suture similarly to other war wounds and subject to the same criteria, that is bacteriological investigation and clinical appearance. The probability of this procedure may be estimated fairly well at the time of the primary operation and in that case the operation itself the preparation of flaps etc. will be governed accordingly.

Where delayed primary union is not possible or when infection is expected progressive sterilization of the wound should be practiced. In this connection the method of applying the Carrel tubes that is in use at La Panne is of value. To square pieces of gauze corresponding in size to the cross section area of amputation stumps at various levels are stitched Carrel tubes in the position and proximity desired. These are prepared beforehand and sterilized. They are applied directly to the wound and afford a sure manner of holding the tubes in place. The troublesome slipping and change in position of the tubes is thus avoided and by using 8 to 12

tube effective distribution of the disinfectant is obtained.

The application of extension to the skin of the stump has proved of great value and its more general use would be desirable. This is particularly advisable in thigh and upper arm cases. The amount of retraction of muscles and skin which occurs is often remarkable. In thigh stumps particularly even quite long flaps apparently disappear totally in the course of two or three days. Such a wound may then appear as almost a plane surface. The application of traction will however make the flaps reappear. Needless to say the length in many stumps may be saved by its more general use. Where traction tends to close the wound it cannot be usefully used when infection is present. This cannot happen when the flaps method of amputation has been used. In this case the use of traction tends mechanically to favor wound disinfection as the surface remains a plane section instead of becoming conical as retraction occurs.

Traction may be applied either by means of a pulley and weight or by using a modified Thomas splint. Each method has its advantages. The extension splint is best adapted for use at the front as it is more compact and can be used for transportation whereas the method with the pulley and weight is best suited to the need of the base hospital.

The splint is a modification of the ordinary Thomas Ring apparatus used for fracture cases. It is shorter and the side bars instead of being parallel are divergent. At the foot end is fastened a square upright frame which serves at the same time as a support for the apparatus and a point of attachment for the extension. The stump is supported on flannel strips fastened to the side bars in the ordinary manner. The traction may be applied either by strips of adhesive plaster or by flannel strips and glue. These are fastened to the skin two inches above the wound and run the entire length of the stump. The number of these to be used and their arrangement depend upon the shape of the wound and the level of the amputation. The ends of the strips are fastened to a steel ring larger in

diameter than the end of the stump. The ring is important because it prevents pressure upon the wound edges and also equalizes the pull. It has two lateral projections which rest upon the side bars of the frame. It is fastened to the end piece either by coiled steel wire spring or rubber tubing which gives the necessary traction pull. Change of direction is very easy as the traction bands are simply unhooked from the ring and the latter passed upward over the end of the stump giving an unobstructed view of the wound. This splint immobilize the stump completely and is very comfortable for the patient.

When the pulley and weight method is used the splint is unnecessary. The ring is retained as it simplifies dressings but the traction is furnished by a cord and weight the latter from 3 to 6 pounds depending upon how much the patient can stand. The comfort of the patient is much increased if the stump is supported upon a swath the ends of which are fastened to short steel bar suspended by cords from an overhead pulley and counter balanced by weight. When arranged in this manner the patient can lift himself easily and move about in bed and nursing is simplified.

It is exceedingly important with any apparatus that tends to elevate the stump to guard against the contracture of certain muscle groups with resulting limitation of joint motion. One of the most frequent causes of failure to develop the maximum benefit from the prosthetic appliances in amputation cases is this limitation of the full range of motion at the joint. Very few thigh cases retain their power of hyperextension at the stump and flexion contractures are the rule below the knee limitation of extension in the forearm loss of supination in the upper arm limitation of abduction are the other common impairments. Precisely those motions are limited which are most necessary to the welfare of the cripple. They are often due to prolonged immobilization of the stump in bad position and can in large measure be prevented. Systematically each day beginning after operation the stump must be made passively to execute in its entirety the motion that is most likely to be affected.

For thigh cases who are too ill to turn over on their faces for the purpose of making hyperextension of the stump another maneuver is substituted. With the patient lying flat on his back a pillow is introduced under the buttocks to elevate the hips. The sound leg is then fully flexed on the abdomen to tilt and fix the pelvis. The stump will be found pointing in the air and it suffices to move this backward as far as possible while at the same time the crests of the ilia are held down by the nurse effectively to guard against flexion contracture. In cases of amputation of the leg the knee should be fully flexed and extended. In amputations of the upper arm the stump should be abducted completely each day. Its maintenance in the abducted position by means of the special traction splint is also advisable and the passive exercise of the stump is then not necessary. Similarly care should be exercised in stumps of the forearm to put them through the normal range of supination and pronation. These simple exercises require very little time and trouble. The traction splint when used does not need to be removed. By removing the flannel supports the stump can be moved inside the splint.

Almost all amputation stumps require secondary operations for closure of the wound. Delayed primary union at the end of 3 to 5 days has already been mentioned and should be done in all cases where bacteriological study justifies it. Secondary suture may be done when progressive chemical disinfection of the wound is successful. In a certain proportion of cases however infection of the bone occurs and the bacteria become inaccessible to the solution. In these cases a simple bone shortening operation with excision of a wedge shaped section of the soft parts may be done. The wound should be left open and it may be possible to obtain chemical sterilization and secondary suture. Even when this is unsuccessful the wound will granulate and close by epithelization in most cases. This may take time but conservatism pays.

A certain number of the resulting stumps prove unsuitable for satisfactory use on account of protruding bone adherent to the

car sinus formation and chronic osteomyelitis troublesome osteophytes or painful nerve endings. Each of these conditions demands appropriate surgical treatment but as a rule this should not be carried out until the lapse of a certain time and when more conservative measures have failed. The excision of an adherent scar with shortening of the bone in an apparently clean case may let loose dormant or encapsulated bacteria and produce reinfection. The extrusion of a sequestrum by natural means may occur after a little time and result in closure of a sinus. Perfection is difficult to obtain and should not be sought for very often it will bring disaster.

Immediately that a stump is able to tolerate pressure on its end steps should be taken to develop its end weightbearing possibilities by inaugurating end pressure exercises. The degree of pressure borne by the stump is graduated and in no case exceeds that which the patient can stand. The stump is first pressed against a box covered by a pillow resting against the foot of the bed. This is done at regular intervals during the day. Later as the end of the stump becomes toughened the pressure exerted is increased. In the standing position the stump is pressed against the seat of a chair at frequent intervals during the day. The force is increased until the patient is actually pounding the end of his stump against it. Care must be used in inaugurating and supervising this exercise as it often causes infection to flare up. For this reason it should not be used in cases where sinuses are present. Unfortunately the exclusion of this class of cases makes the number to whom this procedure can actually be applied comparatively small.

Massage of the muscles actuating the stump is of great value in keeping up their nutrition and in preventing degenerative changes from prolonged disuse.

Long continued disuse is one of the most potent factors of all in preventing complete functional restoration in cases of amputation. This has been due in large measure in the past to the improper recognition of the necessity of supplying prosthetic apparatus at an early date. It is now possible to secure cheap

tubes effective distribution of the disinfectant is obtained

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altogether. This latter I have done in applying the term chronic syphilitic induration of the vulva to the cases I shall report herewith. They are elephantiasis in gross appearance, they may be called esthiomenes if that term is to be restricted to the cases in which syphilis is the causative factor but they are syphilitic in origin are chronic in their course and their structure is of an indurative oedematous type.

It is possible that what may be the largest percentage of cases that are termed esthiomene or elephantiasis vulva have been considered of doubtful syphilitic origin because they are highly refractory to anti-syphilitic treatment of whatever kind or intensity. Moreover the microscopic appearance of syphilitic and tuberculous lesions are often very confusing.

These cases came under observation in the Gynecological Out Patient Department of Vanderbilt Medical School. Of the latest one thousand patients in that department only six cases of syphilitic oedema of the vulva have been noted. Two of these were not very extensive and only diagnosed clinically and are omitted from this report.

**CASE 1.** Gusie C. A widowed mulatto (Lundre) of thirty was seen first on November 11, 1917. She was born in Missouri.

The mother is living and well. The father died of cause unknown. One sister died of cause unknown. One sister living and well. She had 13 half brothers and sisters of whom she knows nothing.

The patient uses tobacco and alcohol. She had measles and chickenpox when a child. La grippe for four weeks five years ago. She states she has had hemorrhoids all her life and that she has pain and passes blood and mucus when her bowels move. Up to six days ago she got up two or three times at night to void. She often has burning on urination.



FIG. 3. C. 1.

No blood. Her menstrual history is entirely normal. She had a miscarriage at four months about ten years ago. The convalescence was uneventful. She denies venereal disease.

About four years ago she noticed a growth about the size of her thumb in the region of the clitoris. This has grown gradually to the present size. About seven or eight months ago she put raw bacon on the growth which caused it to ulcerate but this is now healed. At about the same time she noticed the growth about the anus. There is a burning sensation present at times not associated with ulceration.

Physical examination shows the tonsil to be enlarged. There is a systolic murmur almost entirely replacing the first sound heard best at the apex. The epitrochlear and inguinal lymph nodes are palpable. There is a slight discharge from umbilicus which is depressed. The margins are slightly hardened.

From the region of the clitoris and involving both nymphæ a pedunculated tumor 12x15 centimeter is seen growing. On the right side of this tumor there is a small eroded surface about 4x centimeters. Extending from this forward is a car. The labia majora are very much thickened, hard, not tender and have an appearance of pig skin. Covering the entire perineum and extending back to the coccyx on both sides of the anus is a huge cauliflower growth red and having a very slight discharge. The urinary orifice is normal as are both walls of the vagina.

The urine is normal. The blood is normal save for a 4+ Wassermann.

**CASE 2.** Maggie McC. An unmarried negro domestic of nineteen first seen November 20, 1917. Born in Tennessee. The family history is unimportant. The patient had measles in childhood. She has lost about 30 pound in weight in past year. She has had leucorrhœa for past three months. Periods entirely normal except that she has missed her last period. She has had no children, miscarriages or abortions.

About eighteen months ago the patient noticed a small nodule on left side of vulva. In about three weeks this ulcerated but healed again in about two weeks. Later she noticed a swelling on the opposite side. These have grown gradually and continuously to present size. The patient states that the tumors will become hard and quite painful at night. Pain prevents her from sleeping.



FIG. 4. C. 2.

light provisional apparatus which can be applied immediately the patient is convalescent. Its use prevents the formation of the crutch habit, hinders stump shrinkage and at the same time provides an invaluable means for active mobilization and muscle exercise. Its early application is imperative.

Surgery must devote itself to shortening the period between amputation and convalescence if we are to secure the best result. The earlier our wounded can be made ready for provisional prostheses the greater will be the degree of functional restoration obtained.

## SYPHILITIC INDURATION OF THE VULVA

WITH REPORT OF FOUR CASES

BY J. F. CALLENDER, M.D., IACSN, ST. LOUIS, MO.

TO a large group of cases presenting the symptom complex of chronic enlargement of part with smooth or roughened skin with or without ulceration and microscopically characterized by increased connective tissue formation with lymphatic dilatation (or new growth) the term elephantiasis has been applied. This all inclusive and misleading term has been used to include this condition whether the underlying etiological factor would appear to be intestinal as referred to by J. Schnitzler (1) mechanical obstruction by the removal of the lymph node draining the part mentioned by Rivogli (2) and many other recurrent trepanococic infection alluded to by Hill (3) tuberculous as cited by Vitti (4) syphilis referred to by Lena Kurz (5) Kelly (6) Rivogli (7) and many other or the so called tropical form due to the filaria sanguinis hominis (8) or the bilharzia.

Just twenty years ago Huguier (9) applied the term *elephantomane* to this condition when

involving the vulvovaginal region but neither he nor subsequent writers have made it clear just what is the underlying etiological factor in the condition they term *elephantomane*. Stein and Heimann (10) report a case and quote another from Szasz in which there was cyst formation using the term *elephantomane* in which the causative agent was not determined. Hyde (11) Taylor (12) and Lena Kurz (13) believe all *elephantomanes* manifestations of tertiary syphilis.

It will be seen then that the term *elephantomane* as applied to a clinical manifestation that is constant only in a very general way either in microscopic or microscopic appearance and having a most variable etiology. The same may be said of the term *elephantomane* though its use is restricted in application to the vulva. It would seem logical therefore to restrict the term to a condition that has a definite pathology and etiology or so to qualify the term as to give an adequate conception of the condition considered or perhaps to discard the term.

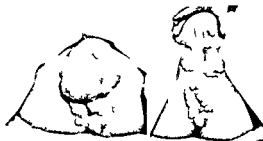


FIG. 1



FIG. 2

region of the clitoris another tumor 3x3x4 centimeter is seen. Beneath the tumors and extending out on the thighs and back around the anus an ulcerated area with elevated edges is seen. This extends into the vagina on the posterior wall. The vagina is constricted about one inch inside just admitting the fore finger. Rectal examination is so painful it is not attempted. The urine is normal. The blood shows a moderate leucocytosis of 11,000 and the Wassermann is 4+.

On removal all the tumors showed a marked tendency to bleed the bases being very vascular. There seemed to be a marked arterial supply and a noticeable absence of veins. The tumor base had an almost characteristic pearly white appearance which exuded a clear serum on pressure. Histologically the specimens showed so striking a similarity in appearance that a description of one will suffice for all. Thickening of the surface epithelium with hypertrophy of the papillae were the noticeable changes in the skin. Underneath these was a noticeable productive inflammation lymphocytes plasma cells and eosinophiles being present. Increased fibrous tissue with oedema and enlarged lymph spaces are noted which latter are infiltrated with lymphocytes and plasma cells. The blood vessels show perivascular infiltration. There are giant cells but no caseous masses.

In the specimen removed from Case 3 A. A. Eggstein of the Department of Pathology of Vanderbilt Medical School has demonstrated the presence of the spirochæta pallida. In a rather full but by no means complete survey of the literature I have not been able to find that this has been done before. Furthermore Comyns Berkley (14) states that up to the present time we find no cases recorded with spirochæta pallida in the tissues affected with esthiomene.

The treatment instituted was the complete removal of the growths with the hiding of skin flaps to cover denuded areas. The condylomatous or ulcerated areas were thoroughly cauterized with the actual cautery. Closure was effected by the use of interrupted silk worm gut sutures. The after treatment was vigorous antisyphilitic medication.

Cases 1, 3 and 4 were seen March 18, 1918.

Case 1 showed four months after operation although she had continued the antisyphilitic medi-

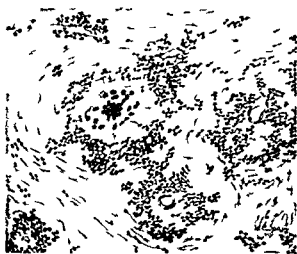


Fig. 6 Syphilitic induration of the vulva showing hyperplasia of the connective tissue many mononuclear lymphocytes especially around the neovascularized capillaries and a characteristic giant cell.

cation which was administered during her sixteen days in the hospital a complete healing and a fairly normal vulva. The condylomatous growth was smaller, no raw surfaces nor any discharge.

Case 3 had discontinued treatment also and showed no improvement other than the absence of the tumors. There were raw areas in the former sites and at the place of removal of the growth. Her Wassermann was again taken and showed a 3+.

Case 4 was given in addition to the mercury and iodides to the point of tolerance one injection of 0.6 gm diarsenal. After dismissal from the hospital she reported regularly for treatment. Although but one month had elapsed there was almost complete healing. The unhealed portion showed a distinctly healthy appearance. The region of the anus did not look so promising.

It is my belief that a radical removal of the growth with a complete and thorough cauterization of the ulcerated areas—cauterization a second time if need be—with intensive antisyphilitic medication will effect a cure in these cases.

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I g. Syphilitic lesion of the lymphatic system. The lymphatic system is shown in the photograph. The lymphatic system is shown in the photograph.

Physiologic lymphatic system. The lymphatic system is shown in the photograph. The lymphatic system is shown in the photograph. The lymphatic system is shown in the photograph.

CASE 3. M. V. I. Mulatto ho s if f 32 n t D m l j o B r T c Th t m l y h i t r v i u n p t a t l l p t t h d m e a s l e a n l h p n g g h i n c h i l d h o l P h r i e n y r a g h a l t y p h l ( ) f v r S h e h a d f e v t v a n l k t o y r S l h a b e e u b l e t f l k t a t l l n c o n t o f c t a c t u a f f l o f t o e a n l l f m c l e s M s t r a t i h b e e n n r m l e x p t t h t l e t l y t h e f l o n t u n l y m o r e a n d s h h s l i g h t p a i n n t h l a b l m S h e h a h a i n h l l r n m i c a g e a l r t s S h h a h a l l o r r h a f o r 5 y r S h t n e e n l l i s e e S h e h a s l o t n o v i g h t

About two g the p t n t n o t d a n e n l a r g m t p p p a t o f p r i v a t e T h i g e v l l y l u t t l l y i n l u n b o t s m o n t h h

n o t d a n u l c r a t i n n l r n t h T h e g r o t h g a l u l l y i n c r e a s i n c T h e r i p a i n o f b u n g h r e t r e a t g h t T h y i d x m i n t n h l o s a p t i e n t h a s i l l y n o u t h e d T h i n g u i n a l l y m p h o f s a r p l a l e B o t h l e t e m i t i e s a r e r a t h e r m l l T h e r i p p a r t i c l y t r p h y o f d u s e o n l y T h e a n k l j o i n t s t r i x e d i n e x t s i o n a l t h t f l o t h f e e t c m a r k e d l l e e d K n e e j a r r a l t

C o i n g t o m t h r g i n f t h e l i t o g t h t o a n t m t r F r m t h l e r s u r f a c i t h i m r a n l p r o j t i n g t o w a r d t h v g a c t m a l l e g o t l I n l t h e n t i p r o u m l a t l g t n t o t h i n g a l f l l l r a t i n g t h a t h l l m k d e l a d l g h i c h a e u n l e m l T h i r a i c o v e r e d t h f u l p r e t l i s c h a g

T h l l s h o t s + W e r m a n n o t h r g t i c U n g t i v

C a s e M I D A g r p r a c t l n u s t o u n a l n l t F e b r u a r y 5 1906 H r f t h r d i l o f h a t l e a n d h e h a s a u n t h o n o h h r t d i a c T h f a m l y t o v i l r g a t i v e T h i n t n t h d t h e d i e o f c h i l d h o d F e r t h p a s t m o n t h h e h a s l a y f l i n g i n t m a c h n a f t e r e a t g S h e h a o m t l v a l t m l u g t h i t m S t m c h s y m p t o m r e l i e l b y d a S h e h a g i t a p p e t t S h g e t p t o r t h e e t m a t i g h t v o i d S h e l m v e r e l d i a e H p o l l g h n p t e t S t h y a e r g u l r t y i g h t l a y t f l i n g t l d y s a n d u s i g t h e c p k s l a l y m d a t l y o i l d S h e h a n g a u n S l e h n t m t r a t l l r n g t h p a t t h r m t h s S l e l l h i l o h i d n m c a r i g e o r a b o t o S h h l l u h a f o r p a t 3/4 v e r

T h r e a d n e h l f y e a g o t h p t i e t b a t o h a v a p f a g a l l h a r g e l a b o u t n m n t h e t i n g b a n t h p e u m T h a f l l d l y o r h i t h p t i t b l e d c u s e l b y t i n g T h e r p r s t e l a n d l t o y e a s a l l g t d o t h i g h t s i d e o f u l v a D u r g t h e p a s t t h e m o n t h t h e l e f t s i d e h s b e c n l n g g M r e r e n t l y m a l l e t u m o r h a p p a l i n t h u p p r t f t h v u l B t e e n t h s t m o v d o u n t i n g t h r u n u l c e r h a b n p r e t s c o u l g n k

P h y s i a l e a m a n t h p t n t l o k l d e r t h a n a g e e n T h e m l m a o f t h e e y h l T h p u p i l a r e q l l y l l a d r e g u l a b u t d o n t r e t t o l i g h t l a c o m m o i t n T h r e i a n e t e r n l q u i t i n f l e x y a l o n y t g m u T h i s m a r k e d d e f o r m i t y f f n t t e e t h T h l p a l p a t e l e c h b l t h e c o s t l m a g T h r i m o t t l e d p p e a r n o f k i n b l o w t h k n e T h e p o t e r v a l e p i t c h l r a n l g u n l l y m p h n d e r e p l a b l e T h f l e s p e n t b t l g g l

I n t h e g h t l b u m a t u m r r x 6 x 4 n t i m e t e I n t h e l e f t l a b m o a l t h l f t a t F r m t h



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Fig. 1. Teratoma with growth could be called in illustration an enchondroma of the testicle because it is composed largely of hyaline cartilage. The chief difficulty, however, is finding numerous teratomatous elements in the tumor.

The tumor represents that class of testicular tumors which teratomatous elements are found with each.

Fig. 2. Teratoma testis showing two specimens of the coarctate testicular tumor. Both tumors consist almost entirely of alveolar embryonal carcinoma, the lymphoid stroma. It is only with great difficulty that their type of tissue can be found. The tumor in the testes are carcinoma. Five if teratomatous elements are not found and a few occur. I believe that such a tumor is a condensed development of teratoma.

The tumor is a representative of the testicular tumor here that, with the lymphoid elements, embryonal carcinoma with lymphoid stroma and the histological elements are found with difficulty, not at all.

subject to weird embryologic processes which result in the various complex and mixed tumors encountered in the adrenals, kidneys and testicles.

It is through the lymph channels that metastases occur chiefly in the retroperitoneal and lumbo aortic nodes. The growth metastasizes as carcinoma and not as teratoma. Recurrences have occurred as early as one month following operation. Howard found that among 110,000 male patients admitted to a number of the London hospitals during a period of twenty years there were 65 cases of malignant testicular disease or about .06 per cent of all male patients admitted. Of 57 cases with complete histories 9 were in ectopic testicles, 8 of these being in the inguinal canal and one just below the external ring. In 1279 consecutive male admissions to the Presbyterian Hospital in New York City there were found 13 malignant testicular tumors. Of these 11 were situated in the scrotum and 2 within the abdomen. Thus in 182,729 male admissions to general

hospitals there were 3 cases of malignant growths of intraabdominal testicles or about 1 in each 60,000 cases. With such statistics it seems no more than right that we should report all cases. Coley during the past twenty five years has personally observed 65 cases of sarcoma of the testicle. In 5 the disease occurred in the entirely descended testicle and in 1 in the undescended. Seventy five per cent occurred between the ages of twenty five and forty five.

CASE 1. A. B. Age 5. Well nourished always healthy. Parents noticed a swelling of right testis which increased rapidly reaching the size of a small hen's egg in one month's time with involvement of the inguinal nodes and overlying skin. The tumor was removed at operation with three enlarged lymph nodes and structures extending up to the internal ring. The wound healed promptly but after two weeks there was increasing anemia, loss of flesh, fever and prostration. One month later several firm nodules appeared in the skin of face and neck. With rapidly increasing anemia, fever and weakness the child died two weeks later.

Cross examination. The tumor of the testis measured  $3 \times 2 \times 2\frac{1}{2}$  centimeters. It involved the

## NEW-GROWTHS OF THE TESTIS

THEIR SYMPTOMATOLOGY, PATHOLOGY, DIAGNOSIS, AND TREATMENT<sup>1</sup>

B. C. R. OCKWORTH, M. D., L. S. A., HARRISON S. MARKLAND, M. D., NEWARK, N. J.

Looking through the literature upon testicular neoplasms one is struck by the variety of diagnoses especially from a pathological standpoint. The classification and description of tumor of the testicle in modern genito-urinary textbooks are so meagre and incomplete as to nothing of being incorrect that the writer thought it would be of interest to bring the subject in more or less detail before the society. The reason for such a diversity of opinion in regard to the type of tumor we are dealing with is due to the fact that the growth was not carefully sectioned or studied enough pathologically or it would have been seen in the greater proportion of cases that we were dealing with a teratoma. For practical purpose there exist only one tumor of the testicle namely a teratoma. The testicular teratoma may appear in two forms either as a complex teratoma containing tissue representing derivatives of all three embryonic layers or as an embryonal carcinoma alveolar or diffuse polyhedral or rounded cell often with lymphoid stroma. The latter is the most common tumor of the testicle and it may or may not be possible to find in such a tumor other evidence of teratomatous element but even if no other teratomatous elements are found it seems reasonable to agree with Ewing in regarding this tumor as a one-sided development of a teratoma. In considering tumors of the testicle nine times out of ten we are dealing with a malignant tumor which requires very early diagnosis and radical treatment in order to prevent metastasis and consequent death. Hence a study of new growths of the testicle comprises the study chiefly of carcinoma of that organ.

During the past eight years we have collected at the pathological laboratory of the City Hospital Newark New Jersey thirteen cases of new growth of the testicle a brief summary of which follows

|         |              |                               |
|---------|--------------|-------------------------------|
| Case    | Age          | Duration                      |
| Case 2  | Age 34 years | Duration 12 months            |
| Case 3  | Age 43 years | Duration 11 months            |
| Case 4  | Age 52 years | Duration 2 years              |
| Case 5  | Age 43 years | Duration 28 months            |
| Case 6  | Age 33 years | Duration 14 months            |
| Case 7  | Age 40 years | Still living after five years |
| Case 8  | Age 33 years | Still living after six years  |
| Case 9  | Age 35 years | Duration 6 months             |
| Case 10 | Age 43 years | Duration 10 months            |
| Case 11 | Age 30 years | Still living after 3 years    |
| Case 12 | Age 43 years | Still living after 4 years    |
| Case 13 | Age 33 years | Still living after 5 years    |

A few points of interest might here be noted. Seven out of thirteen cases that we have been able to follow have already died developing metastases. Of the fatal case the youngest was 31 years the oldest 53. The longest duration of the disease was two years and seven months the shortest ten weeks. Six out of the thirteen cases gave a definite history of trauma. Trauma may have been a predisposing or etiological factor in the six cases and then again it may have been the first thing to draw the patient's attention to the tumor or its increasing size. The size is not dependent upon the length of time the tumor has existed. In one case (9) an undescended testis was the seat of the growth. In the majority of cases the growth was usually low but progressive.

If we go back to the embryological development of the testicle you will recall that it develops from the undifferentiated genital ridge or body which is in close proximity to the wolffian ridge or body the latter a complex structure which when it reaches its usefulness starts to retrogress. In no other part of the body is there such a complex embryological structure therefore the adrenal future kidney and testicle which develop in such close proximity to this region are

starting place of teratoma) No evidence was found of a trace of teratomatous elements

(This case was studied by Dr Ewing and described in his excellent paper *Teratoma Testis and its Derivatives* *Surgery Gynecology and Obstetrics* March 1911)

CASE 2 M G age 34 No tuberculosis or cancer in family Is moderately alcoholic negative venereal Eight years ago he was struck in left testicle by a piece of coal he says that the testicle did not pain or swell after the injury Five days before admission to hospital he had severe pain in left testicle without any apparent cause He felt along the testicle but noticed no swelling The next morning he noticed a lump alongside of the left testicle about the size of a small peanut very smooth heavy and painful

*Physical examination* All viscera were in good condition The lungs were negative In the left half of the scrotum was felt a mass about 2 centimeters in diameter hard independent of the testicle but its movement limited

*Operation* An incision was made in the upper part of the scrotum 4 centimeters long extending upward to the external ring The epididymis was thickened and it was drawn down and the vas ligated near the internal ring In the globus major of the testis there was found a nodular mass the size of a finger nail which encroached slightly upon the testicle The testicle with its structures was removed The wound healed promptly and the patient made a rapid recovery

*Gross examination* The testis measures 2 5x 5x4 centimeters its tunica albuginea is smooth and glistening its parenchyma normal Situated in the globus major of the epididymis and rete testis but not involving the body of the epididymis is an oval firm mass about 1 centimeter in diameter On section this mass is greyish white in color and there are no evidences of caseation The rest of the epididymis is normal

*Microscopic examination* The tumor of the rete and epididymis is composed of diffuse areas of small lymphocytes Many cells show distinct cell body There are no areas of caseation or other evidence of tuberculous granuloma Occasionally there was found small acini lined with cuboidal and flattened epithelium We do not believe these are the compressed tubules of the epididymis or vasa recti and if they are not remnants of certain embryologic tubules they might play an important rôle in proving the teratomatous origin of lymphosarcoma

*Diagnosis* Very early lymphosarcoma of the rete and epididymis containing epithelial structures Duration not traceable

CASE 3 N W age 40 The patient has always been in perfect health Two years ago he noticed small lump in right testicle hard which caused a small amount of pain on pressure The mass grad-

ually grew until it reached the present size He had no pain or discomfort except increase in weight of testicle

*Operation* The testicle was removed the epididymis appeared only slightly thickened in the globus major The wound healed promptly and the patient quickly recovered

*Gross examination* The specimen consists of a solid tumor of the left testis measuring 6x6x9 centimeters of firm consistency On section the tumor cuts quite hard and is well confined to its tunica albuginea which is thickened and laminated The greater part of this tumor shows oval round and irregular branching masses of a pearly white color (cartilage) Numerous cavities from 1 to 4 millimeters in diameter filled with a colloid material of greyish to brown color are seen scattered over a large portion of the tumor Two large cavities 1 centimeter in diameter contain yellowish colored colloid The epididymis is not thickened

*Microscopic examination* The main part of the tumor is composed of irregular islands of hyaline cartilage There are also present bundles of smooth muscle considerable lymphoid stroma areas of fibrosarcoma and a few scattered epithelial lined cavities with low cuboidal cells Some of the larger cavities contain colloid material resembling thyroid acini

*Diagnosis* Teratoma testis containing cartilage smooth muscle and lymphoid tissue

CASE 4 J H age 5 During the last two years the patient has noticed a slowly growing tumor of the right testis which during the last two months has grown rapidly reaching its present size and causing considerable pain For the last six months has lost weight and feels exceedingly weak

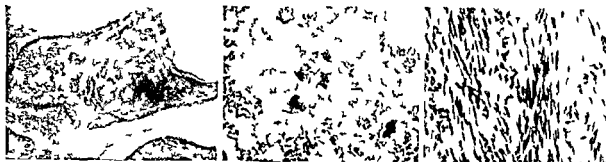
*Examination on admission to hospital* The patient is extremely emaciated dyspnoeic and weak A large tumor is present in right half of scrotum with nodular masses along cord and in inguinal canal Considered inoperable

*Result* Died one month after admission and autopsy showed extensive masses in retroperitoneal glands and metastatic nodules in lungs and liver

*Gross examination* The specimen consists of a solid tumor of the right testis measuring 7x, x8 centimeters On section the lower half shows oval round and irregular masses of cancer yellowish in color and surrounded by fibrous trabeculae the upper half shows extensive necrosis with hemorrhagic extravasation Normal testicular tissue cannot be found The epididymis and cord are extensively involved with solid carcinoma

*Microscopic examination* The large part of the tumor is composed of large celled alveolar carcinoma with extensive areas of necrosis There are also small areas of cartilage fat and smooth muscle tissue In places there is extensive lymphoid infiltration of the stroma

*Diagnosis* Teratoma testis showing large alveolar carcinoma (sarcoma) fat and smooth muscle



I 3    I 4    I 5

I 3 3 I t m t t l h f l m l t I 4 I 3 5 I t m t t h I 5 m th m l Th  
l t 4 F t m t h g h l ll f tl t t t m fr m tl m ll f l g g th i th  
l t t d m ll f h l g h l ll f tl t t t l

pu high r t l i q u i d l y m a i l t the r r f l i f f i l t r t Th lu g  
 th ir t tu th the rr u l i n g t i In a n l h o v i e r l m l i a y l y m p h o m a t a  
 Th e i y g k n th no l f u i n v a l l e l i n o l u l y l i r g d s c t i o n s o t h  
 A m d l f t n f t a c t t e t s h h i t r m g a y h f l l c n e l y n v i l l Throu h o t  
 i t i t l i h o l g n h l t h e i t r o f l i t h t u m r h a p l y i r l l y f i b u  
 l t t Th t u m r f m l l i l l p c o n a l r f o t h c l n e r a l s m l l  
 n d r i m r m l l y m t

The histological feature of the tumor are in all respects typical of malignant lymphosarcoma. That the original tumor arose in the testis seems a necessary conclusion from the relative size of the tumor, that in the testis being much larger than any of the lymph node and showing local out growth of considerable extent as well as extension in the overlying skin. The testicular tissue was found free from invasion by lymphocyte while the rete and epididymis were extensively involved hence we must conclude that the tumor started in the rete and epididymis rather than the testicle proper (which is the



stroma Cuboidal epithelial structures small islands of cartilage and adipose tissue smooth muscle Duration two years three months

CASE 7 F A age 40 Past history and family history are negative The patient noticed a tumor in the right half of the scrotum eight months ago He has lost considerable flesh and strength and complains of dull aching pain in the right iliac region He gives no history of trauma He was under doctor's care four months before he came to hospital

The physical examination is negative

*Operation* The usual incision was made and the tunica vaginalis was found markedly thickened and there were several small nodules felt along the cord The cord was freed well above the internal ring pushing the peritoneum away it appeared normal and was ligated No inguinal or femoral glands were palpable Primary union in wound but the patient had an afternoon temperature reaching 102 F off and on for several days He received 21 injections of Coley's fluid

*Result* Three months after operation the patient complained of indefinite pains in the abdomen under the ribs and over the back of the chest On examination he was quite dyspnoeic no local recurrence of palpable masses was found Two months later a mass the size of a duck's egg developed on the left side of the neck just above the clavicle There was found an indefinite sensation of a mass near the umbilicus with small areas of dullness plus fine râles scattered over both lungs He was cachectic markedly emaciated and extremely weak He died one month later

*Gross examination* The specimen consists of a solid tumor of the right testis measuring 4x6 centimeters oval quite firm in consistency and on section yellowish in color It is quite well confined to the testis except at its inferior pole where it infiltrated the tunica albuginea and tunica vaginalis There is a small clot of blood in the cavity formed by the tunica vaginalis The latter is quite thick over the adherent area On section the tumor is composed of round and oval masses of cancer 1 millimeter to 2 millimeters in diameter there is extensive infiltration of the mediastinum body and globus major of the epididymis The vas shows carcinoma for at least 6 centimeters above the testis

*Microscopic examination* Sections made from the center and edges of the growth show it to be composed largely of large alveolar celled carcinoma containing large vesicular nuclei well defined nucleolus and scanty cytoplasm In many places a typical picture of adenocarcinoma is seen in other areas diffuse carcinoma with lymphoid stroma In addition there are frequent bundles of smooth muscle and small lymph nodes with germinal centers and large areas of necrosis

*Diagnosis* Teratoma testis adenocarcinoma alveolar and diffuse carcinoma lymph nodes epithelial structures and thyroid Duration 14 months

CASE 8 A G age 33 Family history and past history are negative Without any apparent cause two and one half months ago an enlargement started in the right side of the scrotum without pain or other symptoms The patient gives no definite history of trauma

*Operation* The radical operation was done A celluloid testicle was inserted for cosmetic effect Recovery uneventful

*Gross examination* Solid tumor of the right testis measuring 4x6x6 centimeters The tumor is well confined in the tunica of the testis the tunica vaginalis and epididymis are not involved On section hard yellowish and grey in color rather broad connective trabeculae traverse tumor A very small amount of compressed testicular tissue is seen at the lower pole lying just beneath the tunica albuginea

*Microscopic examination* shows the tumor to be composed of large celled alveolar carcinoma with lymphoid stroma and areas of necrosis No other types of tissues were found

*Diagnosis* Carcinoma with lymphoid stroma

CASE 9 F W L age 38 Family history past history and personal history negative The patient has always been well but states that he never had but one testicle in his scrotum and that he was conscious of the presence of the other one low down in his groin Three months ago while attempting to move a large piano he felt a snap in his left groin and when he felt of himself there he noticed he had two testicles in his scrotum but the one on the left side was high up and much smaller He complained of very little pain at the time but in a few weeks this left testicle started to enlarge and was quite painful due mostly to the pulling on the cord

*Physical examination* A powerfully built tall and healthy looking individual Tight up against the external ring on the left side was a firm mass the size of a small orange

*Operation* Orchidectomy

*Result* The wound healed promptly and the patient went home from the hospital in about two weeks Within a month he started to fail rapidly losing flesh and strength and showed clinical evidences of metastases He died six weeks later

*Gross examination* Solid tumor of left testicle measuring 9x9x4 centimeters confined within tunica No remains of testicular tissue are seen On section encephaloid red and yellow areas are intermingled

*Microscopic examination* Carcinoma alveolar embryonal with areas of lymphoid stroma extensive necrosis and hemorrhage Areas of cystadenoma Epithelial glandular structures and smooth muscle

*Diagnosis* Teratoma testis (in an undescended testis) Carcinoma with lymphoid stroma Cystadenoma Epithelial structures glandular Smooth muscle Duration 6 months

CASE 10 H D age 17 Family history previous history and personal history negative For the past five months the patient has noticed a

swelling in the right half of his scrotum which has slowly increased in size. There is no history of trauma. He complains of slight dragging pain probably due to the weight of the tumor.

*Physical examination* reveals a well-nourished young man with all vitæ negative except the right testis which enlarged to about the size of a small orange. No transillumination. His firm feel.

*Operative* Radical periorchidectomy. Gross section: Solid tumor of the right testis measuring 5x6x5 centimeters. On section the grayish and mottled reddish tinge of the color.

*Microscopic examination*: Carcinoma of the lymphoid stroma. Considerable metastatic involvement of the lymphatic system.

*Diagnosis*: Testicular tumor. Carcinoma of the lymphoid stroma. Myofibroblastoma.

*Remarks*: Found a half an inch in diameter. No other changes in the testis. Lung and liver metastases. Duration of disease about one month.

*Case 1*: P. U. G. 30. Initially very painful. History of long gymnastic exercises. Fell at the end of a horizontal bar and sustained a contusion of the left testis. In a few days he was apparently ill but returned to work. Right testis enlarged to the size of a walnut.

*Physical examination*: Testis as negative except for a tumor in the right half of the scrotum.

*Operative*: The radical orchiectomy. Gross section: Solid tumor of the right testis measuring 5x4 centimeters. Quite firm. On section yellowish to grayish white.

*Microscopic examination*: Carcinoma of the embryonic lymphoid stroma. Considerable fibroplastic tissue.

*Diagnosis*: Testicular tumor. Embryonic carcinoma of the lymphoid stroma. Duration of disease at present writing (August 4, 1918) is about one and apparently all.

*Case 2*: F. B. Male age 45. Personal history of trauma. The patient noticed a small lump in the right testis about one month ago which has steadily grown in size until the present time.

*Physical examination*: Negative except for a tumor mass in the right half of the scrotum. No glandular involvement palpable.

*Operative*: Orchidectomy with removal of adjacent structures.

*Gross examination*: Solid tumor of the right testis 3x4x2 centimeters. Tumor confined to the tunica of the testis. Tunica vaginalis and epididymis not involved. On section grayish white and reddish in color. Distinctly cystic about the consistency of a rubber pong.

*Microscopic examination*: Tumor composed chiefly of adenomatous areas with cystadenoma histologically benign. Small areas of hyaline cartilage and smooth muscle.

*Diagnosis*: Adenoma simplex cystadenoma cartilage and smooth muscle. Testis. Duration at present writing (August 24, 1918) patient is alive and apparently well.

*Case 3*: G. K. Male age 32. Past history of family history and personal history negative. The patient thinks he was struck by a baseball in the right testis a few years ago. He now has a swelling in the left side of the scrotum which has been gradually increasing in size for three or four months. The tumor gives no pain or light transillumination.

*Operative*: Orchidectomy with adjacent structures.

*Remarks*: Patient made an uneventful recovery but four months later he presented himself with a lump the size of the peritesticular tumor. He refused further operation.

*Gross examination*: Solid tumor of the left testis measuring 5x6x3 centimeters. On section grayish red in color with small cystic areas.

*Microscopic examination*: Adenocarcinoma of the lymphoid stroma of the carcinoma and without lymphoid stroma. Epithelial structures.

*Diagnosis*: Testicular tumor. Adenocarcinoma of the lymphoid stroma. Epithelial structures.

## DIAGNOSIS

As a rule the patient seeks advice on account of a swelling in either side of the scrotum which he has probably noticed for months and the increase in size has been very gradual. Pain is usually absent unless the tumor is large enough to give a dragging sensation from its weight. The tumor may range in size from that of a horsechestnut to that of a coconut being ovoid in shape. There may be soft semi-fluctuating areas due either to degeneration of tissue in one part or another or to rupture of blood vessels within the growth producing a hematoma or to both. The surface outline as a rule is well defined smooth and slightly lobulated. In large tumors the epididymis is flattened out by pressure and finally becomes invaded by the growth. The tumor may feel hard or semi-solid except when it has an associated hydrocele. The very large growths have a tense elastic cystic feel. The surface blood vessels are greatly dilated and tortuous. The growth itself is non-translucent and

freely movable. Further examination very seldom reveals much of diagnostic value the blood urine etc. has usually been negative.

*Differential diagnosis.* New growths of the testicle are to be differentiated from tuberculosis and gumma. In tuberculous lesions the family or personal history is of help the growth is insidious in onset increases in size more rapidly is associated with pain sometimes fever. The growth first manifests itself as a nodular mass in the tail of the epididymis. Often a chain of small nodules can be felt along the vas deferens. It is only later on in the disease that the testis is involved. Tubercle bacilli may be found in the urine also indurations about the prostate and vesicle. Testicular tuberculosis is usually only one feature of a general genital tuberculosis. Testicular tuberculosis has recrudescences and exacerbations suppuration softening breaking down and fistula formation.

In gumma is a history of syphilis either hereditary or acquired the testicle is evenly enlarged with a clam shell epididymis and nearly always has an associated hydrocele. Positive Wassermann is of help.

#### PROGNOSIS

The mortality is very high and Chevassu reports that of 100 cases treated by castration 81 died 19 recovered.

|                     |    |
|---------------------|----|
| Died within 1 year  | 38 |
| Died within 2 years | 17 |
| Died within 3 years | 9  |
| Died within 4 years |    |
| Date uncertain      | 15 |
|                     | 81 |

Of the writer's thirteen cases seven died as follows

|                |   |
|----------------|---|
| Within 1 year  | 3 |
| Within 2 years |   |
| Within 3 years |   |
|                | 7 |

#### TREATMENT

The majority of surgeons who have operated upon these growths have done little more than castration and excision of the cord.

Such a minor procedure may be sufficient in those cases where a very early diagnosis is made in other words before there is an invasion of the regional glands.

The only hope surgeons can have of decreasing so appalling a mortality as we have in this disease is not only early recognition of the trouble but its removal by the radical operation. Gregoire in 1905 performed the first complete radical operation and since then there have been but few cases reported. The mere fact that we get such a high mortality from recurrence in cases of orchidectomy where we felt the regional glands clinically gave no evidence of involvement while in truth the microscopical examination would invariably reveal an invasion by the growth is sufficient to justify the radical operation in every case.

Coley believes that his own series of cases show that cancer of the testis treated by simple orchidectomy without any appreciable risk and followed by a thorough course of treatment with the mixed toxins of erysipelas and bacillus prodigiosus (also without risk) has a far better prognosis than that subjected to the very extensive laparotomy with removal of the lumbar glands as advocated by Chevassu Hinman and others.

#### OPERATION

The incision which has been most often employed to allow of removal of the testicle and cord and to give access to the lumbar glands commences over the upper part of the scrotum extends up to the external ring along the inguinal canal and is prolonged to a point half an inch above the anterior superior spine the incision then curves upward until it reaches the costal margin at the level of the tenth rib. At the beginning only the first part of the incision to the external ring is made and the testicle and cord are dissected free. If there is any doubt as to the diagnosis the testicle should be incised at this point. If malignant disease is present the operation is continued. The incision is prolonged in the direction defined above and carried through the muscle of the abdominal wall until the peritoneum is reached. The cord is traced until it passes



through the internal abdominal ring and then while the sides of the incision are strongly retracted slight tension is applied to the cord so that its further course may be easily recognized. In its retroperitoneal course the vas is adherent to the posterior aspect of the peritoneum and the next stage in operation consists in freeing the cord and reflecting the peritoneum mesially. The cord is traced down well into the true pelvis and there divided between two ligatures, the cut surface being treated with the cautery or pure carbolic. This may be regarded as the first stage in the operation and requires no extraordinary care. The second stage consists in the free dissection of the fascia over part of the iliacus and psoas muscle together with the contained spermatic vessel and lymphatics and the removal of the glands from off the inferior vena cava and aorta. When the vas has been divided the spermatic vessels are seen no longer to form a rounded bundle but to become spread out. It is therefore necessary to make a wide dissection of the fascia on the outer side and this should extend to the outer border of the psoas. On the inner side the line of division of the fascia should pass mesially so as to cross the common iliac at its bifurcation; the ureter will here be encountered and must be freely exposed. The dissection is then carried along the inner side of the common iliac vessels up to the bifurcation of the aorta. When the left testicle is affected the inner boundary is carried up along the right border of aorta and special care must be taken not to injure the inferior mesenteric

artery. When the right testicle is the seat of the tumor the inner border is continued over the middle of the aorta. In both cases the upper limit is the upper border of the renal veins. Between these boundaries everything must be removed. During the dissection the spermatic vessels are traced up to their junction with the main vessels and must be ligated and divided. When all bleeding points have been secured the peritoneum is allowed to return into position and the abdominal wound is closed without drainage, each of the muscles being stitched up separately.

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## THE RADICAL OPERATION FOR TERATOMA TESTIS

WITH THE REPORT OF FIVE CASES

By FRANK HINMAN A B M D F A C S SAN FRANCISCO CALIFORNIA

TERATOMA testis treated by simple castration is a highly fatal disease with a final mortality of over 85 per cent (1). The desirability of any method of attack that will give better results is obvious. The surgical problem was reviewed by the author in 1914 and summarized as follows:

Cancer of the testicle metastasizes in practically every case first and primarily to a limited zone of lumbar lymph nodes which lie on the aorta for the left testicle and on the vena cava for the right between the bifurcation of these vessels and the renal pedicle (Fig. 1). Communication between these two groups and to deeper or more distant glands occurs only secondarily.

Involvement of these primary lymph nodes may occur early or late and the preoperative duration of the tumor in the testicle its rapidity of growth or its size give no definite clinical indication of the onset or extent of such metastasis but the probabilities increase the longer the duration and the more rapid the growth.

The primary lymph nodes are a very imperfect guard against secondary invasion and metastasis to other gland areas by way of efferent lymph channels or by blood vessels to thoracic or abdominal organs may occur early. Surgical treatment is of no avail after these secondary metastases have occurred. The only hope therefore in a radical operation is the removal of the testicle with its primary lymph area before the disease has spread beyond this zone.

The experience of various surgeons in a total of 46 cases has demonstrated in suitable cases the feasibility and technical ease of the radical operation with a combined surgical mortality in all cases of only 11 per cent (3 deaths from pneumonia, 2 from peritonitis).

Radical operation should never be undertaken when lumbar metastases are recognizable clinically and is applicable only in the fairly early cases in which the disease is

apparently limited. Owing to the deep position of the glands these cases cannot always be differentiated before operation so that every case in which clinically there is no invasion is suitable for radical treatment. The operation should never be performed until after the diagnosis is confirmed (by gross inspection after castration).

Sufficient time has not elapsed and the cases are so scattered that it has not been possible to get the ultimate result in all of the patients treated radically. Forty six per cent are alive one for five years one for four years five for almost three years two for over two years and eleven for one year or less. There is a probable cure in at least four cases which had lumbar glands invaded with cancer at the time of the operation. Simple castration could not have benefited any of these cases and their cure is directly attributable to the early and clean removal of the affected lymph area.

In conclusion therefore it may be stated that the early removal of the testicle with its primary lymph zone is the rational method of surgical treatment of teratoma testis but the extensive nature of the operation and the fact that almost one third of the cases thus treated were found to be inoperable warrants a very careful selection of suitable cases.

Since its publication this conclusion has been both supported and questioned. A recent criticism appears in Gibot's *Modern Urology*<sup>1</sup> in a monograph on tumors of the testicle by Edwin Beer. Even though at present the mortality of this operation is much higher than that of simple castration experience has shown that such is the case with all new operations. The writer feels confident that during the next decade the mortality from this extensive operation will be markedly reduced. Moreover he believes that we are justified in expecting better end results when the gland bearing area is removed. Operations for malignant disease in

other parts surely support this position. The fight against cancer cannot be half hearted. The surgeon must strike hard or fail in his duty. A pronounced adverse opinion appeared in *Annals of Surgery*, 1915, vol. LXIV. An examination of Coley's claims<sup>1</sup> that a far better prognosis is secured by orchiectomy when followed by the use of mixed toxins than by radical operation proves disappointing.

The first successful resection of the lumbar gland bearing area was performed August 26, 1906, by Cuneo of France who removed four enlarged lymph nodes one of which showed teratomatous invasion and the man remained well and free of metastasis for 3 years when he was lost from observation. Raymond Gregoire introduced the operation April 10, 1905, in an inoperable case and has since done 5 operations of which have been successful. Maurice Chevassu strongly champions the principles involved and has himself reported 3 cases. The seemingly extensive and dangerous nature of the operation has discouraged its general use. It is significant that from America with its high surgical standards and recognized surgical ability not a single report can be found in the literature of the successful performance of this operation.

It is the purpose of this paper to emphasize the relative simplicity and the real necessity of radical measures and by way of demonstration to report five successful cases, four of whom would certainly have died from metastases if simple castration alone had been performed and in all of whom the operative difficulties were not great and the post-operative complications insignificant.

#### TECHNIQUE OF RADICAL OPERATION

The operation is done in two parts. In the first a simple castration is performed through a high inguinal incision. The cord is dissected high and divided upon a clamp with an actual

crutery. This clamp is left in place for traction on the spermatic vessels in the subsequent procedure. If the gross pathological inspection of the tumor on section confirms a diagnosis of teratoma the second step of the operation is immediately undertaken.

**Position of the patient.** The position of the patient is of considerable importance in enabling one to get a satisfactory exposure of the pre-aortic area. A medium sized pad is placed under the opposite costal margin. The opposite leg is slightly flexed and the corresponding one kept straight so as to fit the hips in an oblique position. The patient should not be completely on his side but in a position half way between the lateral and dorsal one. The usual kidney position is too extreme for satisfactory exposure. The arms should be folded in front of the patient and the sleeves pinned together to hold them in this position and the shoulders should be more nearly up and down than the hips. The position is a bent dorso-lateral one.

**Line of incision.** The incision is so extensive that certain nerve trunks supplying the abdominal muscles and skin areas over the hip, upper thigh and pubic regions are almost always divided. Nevertheless by curving the incision so as to follow the course of the iliohypogastric and ilioinguinal nerves the larger and more important branches remain uninjured. The incision is extended from the high inguinal one previously made over the external ring to a point about 10 centimeters inside of the anterior superior spine following the general direction of Poupart's ligament and then is carried in a curved direction to about 1 centimeter below the tip of the twelfth rib which it parallels for about half its length (Fig. 1). The fascia of the external oblique is divided from the external ring in the course of its fibers (Fig. 3) and from this point the muscle bundle may be split by blunt dissection as they follow closely the direction of the skin incision. The internal oblique, transversalis and latissimus dorsi muscles are divided with a scalpel in the line of the incision. In making this long cut in the muscles the hypogastric branch of the iliohypogastric nerve should not be divided. The iliac branch however must be sacrificed (In

1 Cases of testicular teratoma. *Annals of Surgery*, 1915, vol. LXIV, p. 100.   
2 *Annals of Surgery*, 1915, vol. LXIV, p. 100.   
3 *Annals of Surgery*, 1915, vol. LXIV, p. 100.   
4 *Annals of Surgery*, 1915, vol. LXIV, p. 100.   
5 *Annals of Surgery*, 1915, vol. LXIV, p. 100.

none of the four cases has there been any postoperative trouble with constipation from muscle paralysis)

*Stripping of the peritoneum* The only difficulty in stripping up the peritoneum is encountered in the lower portion over the iliac vessels and in the neighborhood of the bladder (Fig 4). As a rule the spermatic vessels as well as the ureter tend to strip up with the peritoneum in this portion. When this occurs it increases the difficulty of a clean dissection considerably. It can usually be prevented by putting gentle traction upon the cord at the time the peritoneum is stripped from along Poupart's ligament so as to keep the cord and its vessels recognizable. The peritoneum by gentle gauze dissection can then be stripped back without carrying the spermatic vessels with it. At the point where the vas deferens passes down behind the bladder the peritoneal boundaries may be with difficulty outlined. This dissection should be carefully completed before proceeding with that above. After the vas deferens has been divided at the point where it disappears behind the bladder with gentle traction on the clamp holding the cord the peritoneum usually strips back easily so as to expose the iliac vessels and the aortic bifurcation. The further retroperitoneal exposure of the abdominal aorta is usually not difficult. The gloved hand can be pushed between the psoas and the peritoneal surface exposing in succession the psoas muscles with the ureter overlying them, the lower pole of the kidney and finally the aorta and the vena cava (Fig 5). The peritoneal dissection should be carried high to the renal pedicle. In three cases the largest lymph gland was found at this level and the subsequent dissection of lymphatic areas is much facilitated by a complete and thorough retroperitoneal exposure. The peritoneum with the abdominal contents behind can be held back with moist gauze sponges beneath broad retractors. In none of the cases was the peritoneum opened except in Case 4 when in attempting to dissect out the vas deferens in the inguinal region a small tear was made which was probably due to the fact that stripping of the peritoneum had been attempted high up

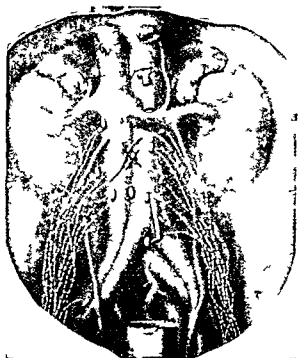


FIG. 1. Diagrammatic representation of the primary lymph nodes of the testicles. (In Cases 2, 3 and 4 a gland the size of a walnut with tumor metastasis was removed from position X.)

before this lower exposure had been completed.

*Resection of lymphatic areas* This is likewise more thoroughly done in two steps: first dissection of lymphatic tissues from off the iliac vessels and aortic bifurcation and second dissection of pre-aortic lymph areas and spermatic vessels. In every case as shown in the illustrations there were masses of lymph tissues lying on the external and common iliacs as far up as the aortic bifurcation. This area had to be cleaned separately from the spermatic vessels. It was easily effected in the four cases by careful blunt dissection with the dissecting scissors beginning low on the external iliac and working along this vessel to the bifurcation of the aorta. At this point lymph tissues may extend deep down on to the sacrum and care in removing them is necessary in order to avoid injury to the middle sacral artery.

The pre-aortic area may be resected in one of two ways from above downward or below upward. With good retraction and complete peritoneal stripping of the area a beautiful exposure is possible. Traction upon the

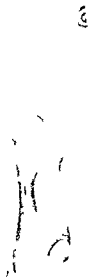


Fig. 1. Kidney, medial view, showing the hilum and the location of the renal vessels and lymphatics.

Fig. 2. Kidney, lateral view, showing the location of the renal vessels and lymphatics.

clump about the peritoneal vessels of considerable help in effecting a clean removal. The ureter should be carefully dissected free of the fascial coverings and held aside by a narrow tape as shown in (Fig. 5). In most of the cases it was found advantageous to conduct the dissection from below upward to within a short distance of the renal pedicle and then complete the removal of the lymph area by freeing its upper portion and dissecting down to meet the former dissection. In two of the cases (3 and 4) the gland and lymphatic were quite adherent to the vena cava in this area. Frequently there was considerable venous oozing directly from the vena cava when small veins were torn or cut at its surface but in no instance was there difficulty in thoroughly ligating these points. In some instances a portion of the wall of the vena cava was seized in the clamp and caught

afterward in the ligature. This was particularly noticeable in Case 4 in which the adhesions were most marked. In this case metastasis to the lymph nodes was extensive and apparently there were numerous small venules directly from the vena cava supplying them. In all instances by careful dissection it was possible to remove the spermatic and lymphatics *in toto*. The spermatic artery can be easily clamped as it issues from the aorta and the spermatic vein as it enters the vena cava or renal vein the point being easily found when gentle traction is placed on the vessel.

**Drainage.** It is of course necessary that drainage be placed after the resection of such an extensive lymph area and this is usually satisfactorily effected by placing a long rubber tube over the aorta down to its bifurcation and curving back above the ilium with exit at the upper back portion of the wound as for kidney drainage. (It would seem feasible in those cases with extensive gland areas and apparent metastases to place a small rubber tube or catheter in the end of which is fastened

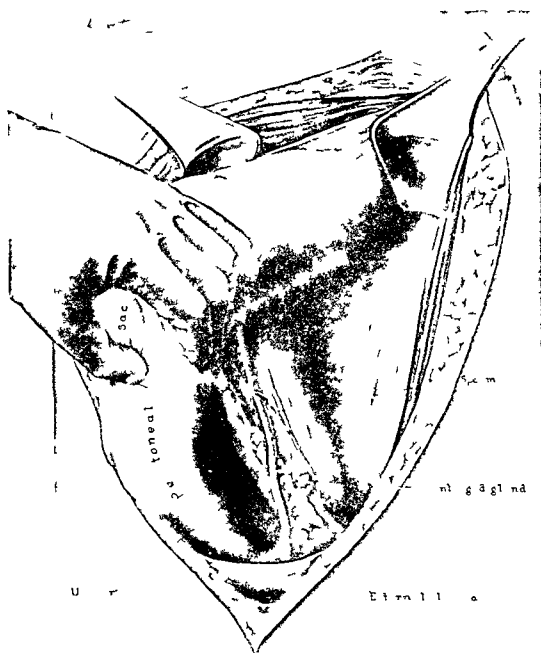
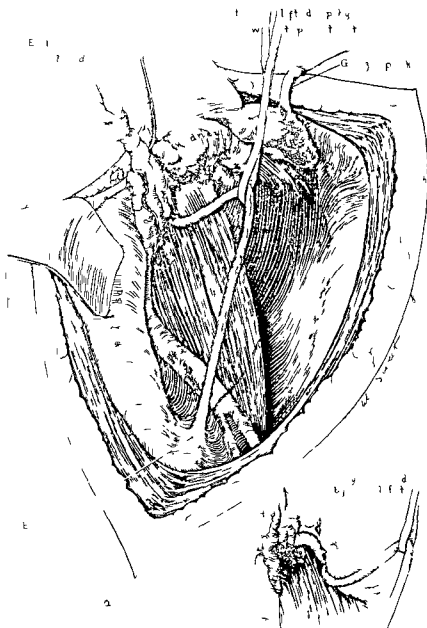


FIG. 4. Drain made at time of operation (case left testis). In this case the drain was placed along the spermatic cord and the peritoneum was closed with the lower part of the drain here the spermatic cord was ligated. The spermatic cord tends to strip up with the peritoneum. The peritoneum is gently tractioned on the prostatic part of the cord.

a 50 milligram tube of radium along side of the rubber drainage tube. In this way the metastatic lymph area could be radiated from above downward by removing the catheter certain distances at intervals of one or two hours.)

**Closure.** Closure should be in muscle layers and thorough. The lower part is best closed for hernia. In closing the muscles special care should be used to avoid including in the ligature any of the long nerve of the abdomen.



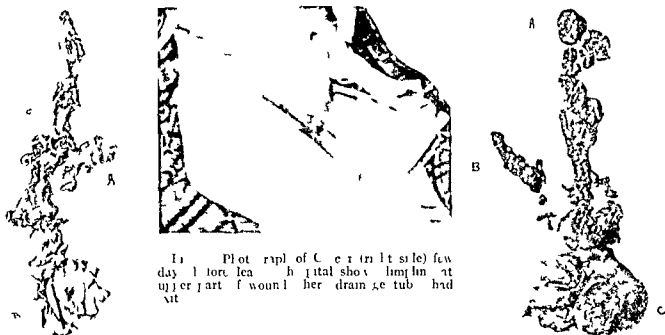


FIG. 8. Photograph of scrotum (right side) showing large tumor mass. The tumor mass is shown in the upper part of the wound. The drainage tube had been inserted.

FIG. 9. Photograph of lymphatic system and fat and fascia from the scrotum of the patient. The lymphatic system is shown in the upper part of the wound. The tumor mass is shown in the lower part of the wound.

FIG. 10. Photograph of specimen removed from Case 1. A large lymph gland which lay between the artery and vein is shown just below the renal pedicle. The tissues from the artery and venous pedicle are shown in the lower portion of the specimen.

the epididymis the patient had bilateral buboes which were incised. No complication with the second attack of gonorrhoea.

Physical examination showed a rather well developed and well nourished ambulatory male. The skin was negative except for operative scars in the inguinal regions. Sclera and mucosa negative. Lymph node negative except inguinal excised. The head was peculiarly molded. The pupils were circular and equal, reacted to light and accommodation. There was an obstruction on the right side of the nose. He had pyorrhoea. Much dental work had been done. The tongue protrudes slightly to the left. Thyroid negative. Chest deep anteroposterior diameter with fairly well marked dorsal kyphosis. Lung resonant and breath sound fair. Heart pulse normal, sound regular and of good quality. No murmur. Abdomen muscular, held taut. Liver and spleen not felt. No masses felt. Reflexes lively. Spine kyphosis somewhat marked in dorsal region but mobile.

Genital point circumcised shows scars on glands from old infection. Left testicle of normal size. Left epididymis probably slightly enlarged at lower pole. Right testicle is a ten centimetre fairly formed non-painful oval mass 4 by 6 centimetre with epididymis loosely attached to back of it. No fluctuation. Light not transmitted. No nodulation. There is a cord-like mass at the upper anterior pole which is painful when rolled under the finger. Vas deferens not enlarged. Skin of scrotum freely movable over the tumor mass throughout.

Owing to the past history a tentative diagnosis of gumma was made. Three successive blood tests were all negative and two salivary administrations caused no noticeable change in the tumor two weeks later. The patient was advised of the probability of tumor.



FIG. 9. Photograph of patient Case 1 taken by Dr. Craig in Lake City after returning home four months after operation.





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 f r o m t h b l o o d v e e l s b e e a t h i t h t h e r i n g



F g i D g l p o m g n t t ) f r g i l  
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Fig. 3. Photograph of patient Case 3 today before discharge from hospital. (Heavy scar appearance due to wound here just been painted with iodine.)

scissor. Stripping of the fascia, the lymphatics and the spermatic vessels along the vena cava above this point was very easily accomplished. At no time was there any extensive hemorrhage. A photograph of the specimen removed is shown in Figure 6. The peritoneum was at no point penetrated. The patient's condition at the end of the operation was good. Convalescence was uneventful until the twelfth day when the patient complained of severe pain down the left leg (operation on right side). There was marked tenderness over the femoral vessels and distention of the superficial veins with considerable edema. There was no rise of temperature. Pain in the leg had practically disappeared in two days but the swelling persisted for several weeks. The patient seen in consultation by H. W. Allen. The condition was attributed to a phlebitis. He left the hospital at the end of three weeks and has been seen several times since then. The soreness in the left leg persisted for a short time but he has had absolutely no tenderness or soreness in the region of his incision (Fig. 5). There has been no abdominal relaxation and during his convalescence his bowel moved regularly and without the need of any special cathartics. The patient was shown before the San Francisco County Medical Society in March and was last seen on June 1, 1915. At this time six months since operation he was perfectly well. The slight stiffness of the left leg has entirely disappeared. He has been working for some weeks. There is no evidence of recurrence locally or retroperitoneally. The abdominal scar is in excellent condition. Pathologic report: teratoma testis; no metastases to gland area found.

CASE 4. R. B. W., age 30, referred by Dr. Craig, Lakeport.

A farmer with a good family and personal history who has lived all his life in California struck his left testicle against the horn of a saddle seven years ago.



Fig. 4. Photograph of specimen of Case 4, which is a pure seminoma with metastases to large gland at 3. 1. Tumor and cord removed at first part of operation. 2. Lymphatic and fascia from off iliacs and aortic bifurcation. 3. Tissue removed from pre-aortic area, the large gland about 2 centimeters below level of renal pedicle.

A short time afterward he noticed a small lump on the left testicle which gradually grew until within a year there was a mass twice the size of a normal testicle on this side. The condition remained unchanged until in April 1911, when after rowing a boat it became painful and it has since been slowly increasing in size and is always painful after hard work. For a month there has been a fluctuant sac at the upper portion which has been tapped by Dr. Craig and considerable straw-colored fluid withdrawn. The sac quickly refills and becomes tense 3 to 4 days after tapping. A needle was thrust at the time of the last tapping into the old lower portion with the discharge of only a few drops of blood. The patient is unusually strong and healthy and physical examination reveals nothing. The abdomen is negative. There is no tenderness nor masses. Reflexes are all active. Blood Wassermann negative. In the left scrotum is a large ovoid mass 8x14 centimeters in size. The skin over the lower portion is reddened (probably by friction of clothes) but is everywhere freely movable over the mass. The upper portion is fluctuant and translucent and extends as a tense globular mass to the external ring. The vas can be felt at the back. It is not thickened and leads to a softer non-fluctuant mass at the base which appears to be a small remnant of the testis. In between is a third round firmer somewhat fluctuant tumor the outlines of which are indistinct.



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Fig. 13. Photograph of scrotal skin at day before discharge from hospital. (Healed scar area due to wound having just been painted with iodine.)

**Sci sor** Stripping of the fascia, the lymphatics and the spermatic vessels along the vena cava above this point was very easily accomplished. At no time was there any extensive hemorrhage. A photograph of the specimen removed is shown in Figure 6. The peritonum was at no point penetrated. The patient's condition at the end of the operation was good. Convalescence was uneventful until the twelfth day, when the patient complained of severe pain down the left leg (operation on right side). There was marked tenderness over the femoral vessels and distention of the superficial veins with considerable edema. There was no rise of temperature. Pain in the leg had practically disappeared in two days but the swelling persisted for several weeks. The patient seen in consultation by H. W. Allen. The condition was attributed to a phlebitis. He left the hospital at the end of three weeks and has been seen several times since then. The soreness in the left leg persisted for a short time but he has had absolutely no tenderness or soreness in the region of his incision (Fig. 1). There has been no abdominal relaxation and during his convalescence his bowel moved regularly and without the need of any special cathartics. The patient was shown before the San Francisco County Medical Society in March and was last seen on June 1, 1915. At this time 18 months since operation he was perfectly well. The slight stiffness of the left leg has entirely disappeared. He has been working for some weeks. There is no evidence of recurrence locally or retroperitoneally. The abdominal scar is in excellent condition. Pathologic report: teratoma testis; no metastases to gland area found.

**Case R. B. W.** Age 30 referred by Dr. Craig Lakeport.

A farmer with a good family and personal history who has lived all his life in California struck his left testicle against the horn of a saddle seven years ago.



Fig. 14. Photograph of specimen of Case 4, which is a pure seminoma with metastases to the gland at 3. 1. Tumor and cord removed at first part of operation. 2. Lymph tissue and fascia from off iliac and aortic bifurcation. 3. Tissue removed from pre-aortic area with large gland at 4 centimeters below level of renal pedicle.

A short time afterward he noticed a small lump on the left testicle which gradually grew until within a year there was a mass twice the size of a normal testicle on this side. The condition remained unchanged until in April 1917 when after rowing a boat it became painful and it has since been slowly increasing in size and is always painful after hard work. For a month there has been a fluctuant sac at the upper portion which has been tapped by Dr. Craig and considerable straw-colored fluid with drawn. The sac quickly reill and becomes tense 3 to 4 days after tapping. A needle was thrust at the time of the last tapping into the solid lower portion with the discharge of only a few drops of blood. The patient is unusually strong and healthy and physical examination reveals nothing. The abdomen is negative. There is no tenderness nor mass. Reflexes are all active. Blood Wassermann is negative. In the left scrotum is a large ovoid mass 8x4 centimeters in size. The skin over the lower portion is reddened (probably by friction of clothes) but is everywhere freely movable over the mass. The upper portion is fluctuant and translucent and extends as a tense globular mass to the external ring. The vas can be felt at the back. It is not thickened and leads to a softer non-fluctuant mass at the base which appears to be a small remnant of the testis. In between is a third round firmer somewhat fluctuant tumor the outlines of which are indistinct.



1st March while at work the patient slipped and apparently strung himself. The right testicle which had been atrophied since the patient had the mumps became swollen and tender. Navy Hospital found Wassermann positive and he was discharged. He was given some desultory local treatment and the above mentioned anti-lutetic treatment. The testicle has not grown appreciably since its first appearance.

Fairly well developed and nourished man. His hair was normal. Eyes Pupils a regular reaction to 1 and d. Extrinsic muscles normal. Nose negative. Mouth teeth show marked pyorrhea. Ragged tonsils. Neck cervical adenitis of moderate degree. Thorax well clothed. Moves equally on both sides and normally. Lungs negative. Heart not enlarged. Sounds clear and regular. No murmurs. P<sub>2</sub>A<sub>2</sub> but not accented. Abdomen negative. Spleen and liver not enlarged. *No masses palpable.* Genitalia penis shows scars of chancres. Left testicle normal. Right testicle entirely replaced by a tumor mass the size of a goose egg. The mass is smooth moves freely beneath the skin is quite hard and not very tender. It does not transmit light and is not fluctuant. Reflexes patellar hyperactive. Achilles positive.

July 16 1918 A diagnosis of gumma of right testicle was made and the patient discharged for treatment and observation in outpatient clinic. July 23 patient reentered the Hospital. Had received 0.6 arsphenamine at the clinic on July 18. Examination on reentrance showed slight though definite increase in size of the tumor. Its character otherwise was unchanged. July 24 arsphenamine 0.6 intravenously. July 6 blood pressure 125/75. The probability of malignancy was explained to the patient and his consent to operation obtained.

*Operation.* July 27 An incision was made over the external inguinal ring the spermatic cord and its accompanying vessels picked up and the tumor delivered from the scrotum. On section the tumor proved to be a teratoma of the testicle. The patient was turned on his side and the radical operation immediately undertaken. A large metastatic gland which was quite adherent to the vena cava was found just under the lower pole of the right kidney. Photograph of specimen removed is shown in Figure 10. Condition of patient on leaving operating room fair.

July 28 patient feels very sore day after operation. The wound is clean. The drain has oozed considerable blood. August 1 rubber drain removed. August 4 stay sutures removed. Several small stitch infections were touched with iodine. August 5 stitches removed. Drainage at several points along incision. Wound was closing partly *per primam* and partly by second intention. General condition of patient good. August 14 condition of patient splendid. Wound almost healed. August 18 the patient is lying pain over chest on both sides near clavicle and also over precordia. No dullness to percussion. A fine crepitus is audible on expiration over small area just medial to left nipple. The pulse regular but poorly

sustained. The dressings were changed. A small bleb containing serum was opened and treated with iodine. August 24 the patient was discharged. His condition is excellent. The wound healed as shown in photograph Figure 13. The patient is to report to clinic for antilutetic treatment. He was last seen in my office September 20 1918 at which time he was in excellent condition with no abdominal masses.

*Pathologic report.* Teratoma testis with extensive metastases to large lymph gland. Other tissues negative for metastases.

CASE 4 V S P age 9 male referred by Major Chidester. His health is excellent. He had pneumonia, typhoid at 13 no operations. He denies venereal disease. About March 1 1918 the patient noticed that the right testicle which was somewhat undersized up to that time started to grow rapidly to the size of a lemon and was diagnosed hydrocele. There was considerable dragging pain and it interfered with walking. He was sent for hydrocele operation to Dr Chidester who found a solid tumor upon exposure and on account of not having patient's consent did not do a castration.

Physical examination shows a man weighing 210 pounds general condition good. Eyes myopia 20/70 ears normal skin and mucous membrane negative. Slight bilateral inguinal adenopathy. Vascular system negative. Blood pressure 122-80 heart normal size no murmurs tones good lungs chest well formed good resonance no rales. Abdomen negative no masses palpable. Nervous system normal. Wassermann negative. In the right side of the scrotum is a tumor about 7x10 centimeters involving testicle. It is hard rounded but presents no areas of fluctuation and does not transmit light. The skin over it is freely movable. Vas deferens is not thickened. Epididymis is localized at back of mass. Left testicle negative. July 14 1918 he was given preoperative arsphenamine. Wassermann July 20 1918 again negative. The probabilities of tumor were explained to patient and consent to operation obtained.

Castration was performed through a high inguinal incision. The tumor was immediately opened and showed uniform transformation into tumor tissue with more or less extensive areas of hemorrhagic necrosis throughout. It differed from all three former tumors in its soft pulpy consistency and uniform greyish character.

No testicular tissue could be seen. Diagnosis of seminoma was made and radical operation immediately undertaken. A very large gland was removed as in the two previous cases from the surface of the vena cava and aorta about 3 centimeters below the renal pedicle. This growth was quite adherent but was successfully removed together with all spermatic vessels fascia fat and lymphatics in one piece. Figure 14. It was in this case that the dissection was considerably helped by tying the spermatic vessels at point close to the aorta and renal vein and stripping from above downward to the adherent gland area to meet the previous dissection from below upward.



dilated veins over cheeks Sclerae negative Mucous membranes negative Hypertrophied submaxillary lymph glands Posterior cervicals and epitrochlears palpable Hair scalp and nose negative Pupils of eyes equal regular react to light and distance Deaf in left ear Teeth poorly kept Tongue protrudes in midline without tremor Chest well developed Right chest more prominent than left Movements equal Lungs negative Heart normal in outline sounds good quality regular No murmurs audible Spleen not palpable kidneys not palpable Few dilated venules over cervical region Prominence of ribs on left side Immobility of lumbar spine on flexion extension and lateral movements Extremities negative Reflexes normal In the right epigastrium can be felt large hard nodular masses located midway between umbilicus and symphysis and extending under the border of the rectus The glands on the right immediately at the external inguinal ring are large and firm The superficial inguinal glands are small and the deep inguinals are not enlarged Superficial inguinals are similar to those on right

Genitalia right side of scrotum is occupied by a hard tumor mass roughly cone shaped with the apex at the right external inguinal ring The mass is not tender nor lobulated nor is there any distinct separation of the mass into different portions but there seems to be a slight change in contour at about its center The skin is normal over it No fluctuation present Does not transmit light cannot be reduced into abdomen The epididymis is palpable and seems to be thickened In the cord and about 2 centimeters from the mass is a small nodule 2 centimeters in diameter attached to the cord not tender Dimensions of the mass 12 centimeters long 7.5 centimeters in width and 2.4 centimeters at its greatest circumference Wassermann negative X-ray of epigastrium negative Prostate normal size Seminal vesicles not palpated Suggestion of a mass on right side can just feel a slight fullness with tip of finger Orchidectomy with removal of inguinal glands

Diagnosis mixed tumor right testicle with retroperitoneal metastases

Condition of patient on discharge from hospital There is still an open wound with some slough and discharge The skin is somewhat reddened about it The metastases (tumor masses) in the epigastrium remain about the same The patient has lost 1 1/2 pounds since entry Discharged February 6 1917

Subsequent history This patient was seen in the dispensary on several occasions during the next few weeks He continued to lose weight and the abdominal masses gradually enlarged Death occurred two months after castration

Autopsy Enormous metastatic tumor masses in the pre-tortric retroperitoneal space and nodules in the liver and lungs with same histologic picture as testicular tumor

Pathologic report Mixed tumor of testicle malignant

It has been possible in each one of these five cases to perform a clean complete removal of the primary lymph zone of the testicle No great operative difficulties were encountered A large metastatic gland was removed from the surface of the vena cava in two of the cases with some difficulty on account of adhesions and numerous small blood vessels In Case 5 only was there an operative hemorrhage that could not be immediately controlled

Convalescence in each case has been practically uneventful The only complication has been a phlebitis (Case 1) of the opposite leg which has cleared up completely

These cases furthermore give definite and indisputable confirmation of Most's studies of the testicular lymph zone In three cases (2 3 and 4) an enormous lymph gland was removed from off the vena cava just below the renal pedicle In each gland definite metastases were present Careful pathologic study has failed to discover metastatic growth in other lymph vascular or fascial tissues removed in these cases Nevertheless the finding of tumor cells along the nerve trunks of the cord in Case 5 is most significant The difficulty of microscopic recognition of early lymph metastasis is well known And although no metastasis has been found in the tissues of Case 1 it does not necessarily follow that simple orchidectomy would have sufficed Numerous lymph areas which correspond to the primary metastatic lymph zone so well established experimentally and clinically were removed Their removal offers 100 per cent safety by Bloodgood's criteria A cure in anyone of Cases 2 3 4 or 5 will have been due directly to the early and radical removal of metastatic growths The pathology of these tumors and their metastases is of interest<sup>1</sup> Only one (Case 4) is a pure seminal epithelioma (seminoma) the other four being typical teratomata (teratome) The observation of Dr Ophuls of tumor cell metastasis along a nerve trunk of the cord in Case 5 has special significance This mode of transference has been long recognized as not infrequently occurring in tumors elsewhere as in tumor of the jaw

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The coincidence of a strongly positive Wassermann in Case 3 emphasizes the necessity of close study of all testicular gummata and the wisdom of advising castration for purposes of diagnosis in all instances of doubt.

#### CONCLUSIONS

1 The radical operation for teratoma testis is justified in suitable cases by the high mortality following simple castration by the definite experimental and surgical demarcation of the primary lymph zone and by the possibility of the clean and complete removal of this zone.

The radical operation is neither technically difficult, dangerous, nor mutilating as is proven by the fact that it has been successfully performed and the primary lymph zone completely removed in five cases of teratoma testis without a single troublesome operative or postoperative complication.

3 These five surgical successes indicate that the mortality from this seemingly extensive operation should be little if any greater than that following castration. All five cases enjoy perfect health now 9 months, 1 month, 4 months, months, months and

3 years and 6 months respectively since operation.

4 The ultimate result in these five cases cannot be known for years. But the finding in four cases of metastatic tumor tissue in the lymph areas radically removed demonstrates the uselessness of simple castration and the necessity of radical surgery. A cure in any one of the four certainly and possibly of the fifth will have been directly due to the early and clean removal of the gland bearing area.

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## SPLENECTOMY IN DISEASES OF THE SPLEEN

## REPORTING FOUR OPERATIVE RECOVERIES

BY E. M. PRINCE, M.D., BIRMINGHAM, ALABAMA

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OF the many diseases which seem to depend on some disordered secretion from the spleen none is more interesting than Banti's disease (1) because its pathology is not understood and leaves a wide field for speculation and a wider one for experimental study (2) because while we are not familiar with the pathology of this condition we do not know how this condition may be relieved. The results from surgical interference are all any one could wish for from any surgical operation. The mortality in this condition is or should be almost nil if the case is properly studied and the proper measures are carried out for the protection of the patient before and during operation. When the patient is very anemic one should not hesitate to obtain a suitable donor and give the patient a liberal blood transfusion by one of the methods now in use. Personally I prefer the use of the whole unaltered blood either by the direct anastomosis of the vessel from donor to recipient or by the use of Linton Brown tubes. The latter has been much more satisfactory in my hands. It is almost needless to add that the donor should be examined with great care to ascertain that he is free from transmissible diseases.

The use of nitrous oxide anesthesia in this condition is also a very important part of the technique for it has been so thoroughly proven that the hemolysis seen often after the use of ether as an anesthetic and the reduction in hemoglobin is never seen after the use of nitrous oxide. Also for the past five years I have used a slight mixture of pure CO<sub>2</sub> gas prepared by the Ohio Chemical Company with the gas oxygen. This accomplishes two purposes (1) stimulates the patient and (2) stimulates the respiration. This was suggested to my mind after hearing a most excellent talk at the Academy of Medicine in New York by Randall Henderson who had gone deeply into the subject of carbon di-

oxide as a stimulant. He reported several cases in which it seemed he had succeeded in almost bringing the dead again to life by the proper use of CO<sub>2</sub> gas. I have found it exceedingly valuable in anesthesia.

The operation of splenectomy is usually not a difficult one although if there are adhesions present and the organ is a large one it may cause some anxiety to the surgeon before he has finished the operation. If the pedicle is a very short one it will add materially to the difficulty of the operation just as will the same condition when encountered in nephrectomy.

The splenic artery may be ligated separately also the veins one finds in the pedicle. I first ligate the pedicle *en masse* and then after removal of the organ ligate separately the vessels which may readily be picked up after the organ is severed. I use heavy catgut for all ligations and have never had cause to regret its use.

The operator should be exceedingly careful not to injure the pancreas diaphragm colon and stomach as it is possible by rough handling to injure any one of these organs.

Unless there have been many adhesions broken up accompanied by some oozing which cannot be entirely controlled drainage is unnecessary.

The reports of the following four cases I think are of interest because two of them I have been able to follow up for ten years. One of the remaining two I have been unable to locate after one year. The last one is a recent case of only a few months. In some respects the blood after operation has presented many of the usual phenomena reported by other operators in some other respects it had differed materially.

CASE 1. F. D. male age 6 born in Sicily. The family history is negative. The patient had been a farmer by occupation a hard worker and had never used alcohol. He had always been a



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heartly eater. He came to America twenty years ago. His past illness consisted in periodic attacks of malar. As a young man in Sicily he had a spell of fever lasting about four weeks. Six years ago he was rejected by military authorities in his native country on account of a large tumor in the left side. Up to this time the patient says he knew nothing of the existence of the tumor. He thinks he had smallpox at six years of age. The patient thinks he has been growing weaker for years but only consulted a doctor two months ago for severe pain in the left side over the region of the tumor. This pain would run up and down the left shoulder. The bowel moved regularly. He has had occasional hæmorrhages from the bowel which he supposed to be internal piles, alone or twice ever. Hemorrhage from the lungs or stomach. On examination the patient's lung and heart were found normal. The liver was very slightly enlarged and freely movable. The veins were tender over the gall bladder and appendix. The kidneys were not tender and both could be located in the proper place. A large mass was felt in the left hypochondriac region which also extended deeply into the left lumbar region. The mass could be seen to glide under the anterior abdominal wall on deep inspiration and expiration but seemed to be firmly fixed posteriorly and was quite tender on palpation and percussion. The urine was negative. Taking into consideration the blood picture and history a diagnosis of Banti's disease or splenic anemia was made and operation advised.

**Operation.** General oxygen anesthesia was used. An incision about 8 inches long was made beginning under the costal margin near the ninth costal cartilage and extending downward and outward for about eight inches. The enlarged spleen was exposed.

Extremely many adhesions were found to exist between this organ and the abdominal wall. The adhesions throughout were found to be plentiful and the bleeding very troublesome as every denuded area seemed to weep blood. Where the adhesions were broken up between spleen and lateral abdominal wall it became necessary to leave in two hot abdominal packs in order to control the oozing.

His convalescence was uneventful except for two elevations of temperature due to the formation of stitch abscesses.

The spleen weighed 56 ounces. The report of J. S. McLester on the pathologic findings is appended.

The organ is firmer than normal, cuts very hard, is normal in color and has a greatly thickened capsule.

In the interior of the organ is a cavity about the size of a hen's egg. Smears made from the contents of this cavity show softened splenic pulp and pus. Culture made from this pus gave the typhoid bacillus in pure culture. This organism was identified by E. M. Mason, State Bacteriologist.

Microscopic sections made from the organ show great increase in the size and number of the fibrous trabeculae. The fibrous framework seems to be enormously hypertrophied. The parenchyma cells are increased in size and number and the glomeruli can be distinguished only with difficulty. Irregularly defined patches of pigmentation are seen. The elements are some swelling and proliferation of the endothelial cells of the cavernous veins.

Dgnosis: Chronic interstitial splenitis.

The following blood picture of this case is interesting:

**Examination of blood before operation.** August 3, 1900. White blood count 10,000. Red blood count 4,000,000. Haemoglobin 50 per cent. August 26, 1900. White blood count 18,000. Red blood count 100,000. Haemoglobin 45 per cent. Blood pressure 115. Malar negative. Widal negative.

Unfortunately the record of differential count before operation is lost therefore it cannot be given accurately and is omitted from this report.

**Examination of blood after operation.** August 8, 1900. White blood count 10,000. Red blood count 8,500,000. Haemoglobin 60 per cent. Polymorphonuclear 64 per cent. Large mononuclears 7 per cent. Small mononuclears 1 per cent. Eosinophiles 17 per cent. Blood pressure 95. September 1. White blood count 25,800. Red blood count 2,940,000. Haemoglobin 70 per cent. Polymorphonuclears 68.

per cent large mononuclears  $11\frac{1}{2}$  per cent small mononuclears  $6\frac{1}{2}$  per cent eosinophiles 14 per cent Blood pressure 120

September 3 white blood count 1 000 red blood count 4 000 000 hæmoglobin 70 per cent polymorphonuclears 88 per cent large mononuclears 4 per cent small mononuclears  $4\frac{1}{2}$  per cent eosinophiles  $3\frac{1}{2}$  per cent Blood pressure 115

September 11 white blood count 14 000 red blood count 4 200 000 hæmoglobin 75 per cent polymorphonuclears 7 per cent large mononuclears 5 per cent small mononuclears 0 per cent eosinophiles 3 per cent

September 15 white blood count 17 500 red blood count 4 40 000 hæmoglobin 5 per cent polymorphonuclears 71 per cent large mononuclears 7 per cent small mononuclears 18 per cent eosinophiles 4 per cent

September 30 white blood count 14 000 red blood count 4 520 000 small mononuclears 14 per cent eosinophiles  $\frac{1}{2}$  per cent hæmoglobin 85 per cent polymorphonuclears  $74\frac{1}{2}$  per cent large mononuclears 9 per cent

October 10 white blood count 8 000 red blood count 5 000 000 hæmoglobin 90 per cent

At this time (April 15 1910) about eight months since operation the patient is in perfect health has gained 53 pounds in weight and is at work as a day laborer

The foregoing report was made at time of operation This patient reported to me several times per year for seven years and he was still engaged as a day laborer and his health was good Several blood examinations during this time showed his blood picture to be practically normal

CASE 2 Splenic anemia Mrs T J white aged 26 married American born entered the infirmary November 5 1911 Her father died when quite old of some unknown cause Her mother died of congestive chill Two brothers are dead one died in infancy the other through accident She has eight sisters all living and in good health

The patient had jaundice when 4 years old and a second attack two weeks previous to entrance into infirmary She does not think she ever had a spell of fever of any kind except following the birth of both her children Menstruation began at 14 years It was regular scanty and lasted for only one or two days at this time she suffered quite a little pain She had been married about five years and is the mother of two children the oldest being 3 years of age the youngest 1 year The labors were normal but were followed by infection each time which confined her in bed several weeks

The present illness began five years ago with vomiting of blood which was about half a cupful The blood vomited was very dark red Since this time she had vomited blood almost daily in small

quantities up to October 1910 and since then about once a month She suffered no pain the appetite was poor The bowels moved from three to five times daily there was no blood in the movements She suffered from nausea headache and vertigo She said her temperature was usually elevated in the afternoon She had no cough

Examination revealed a very frail anæmic woman whose skin showed a marked icteroid hue and one would think she had lost much flesh during the past few months She said her weight now was 90 pounds and that she had lost 25 pounds during the past year Her lungs and heart were found to be negative She had no enlarged glands in the neck The thyroid was not enlarged The tongue was very pale and the gums and lips showed a marked anemia The liver was uniformly enlarged but was freely movable on deep inspiration The abdomen was very much distended by a large tumor which occupied the left hypochondriac region part of the epigastric lumbar and the umbilical regions The tumor was slightly tender from pressure and was fixed posteriorly The inguinal glands were not enlarged The patient's feet and ankles showed marked oedema

Vaginal examination revealed a retrodisplaced and fixed uterus which was quite tender The urine showed a trace of albumin otherwise it was negative Blood examination November 5 1911 revealed white blood count 5 850 red blood count 1 776 000 hæmoglobin 5 per cent (Sahli) color index 0.89 Differential count revealed small lymphocytes 30.6 per cent mononuclears 20 per cent polymorphonuclears 43.6 per cent eosinophiles 2.3 per cent mast cells 0 per cent myelocytes 3.5 per cent On account of the long period of years covered by illness the hæmorrhages etc a diagnosis of chronic splenic anemia or Banti's disease was made and the patient was advised to stay in the infirmary in order to see if she could not be gotten in better condition for operation She did not improve but seemed to grow worse

Blood examination November 6 1911 revealed white blood count 5 400 red blood count 1 520 000 hæmoglobin 19 per cent (Sahli instrument used) Color index 0.65 Differential count revealed small lymphocytes 2 per cent mononuclears 20 per cent polymorphonuclears 56.5 per cent mast cells 5 per cent myelocytes 1 per cent

The patient was dismissed from the infirmary as an inoperable case November 26 1911 a blood examination on this date showing the same as on the 20th She returned home and under treatment improved to some extent and was returned for operation March 17 1912 Her condition at this time was not good but was somewhat more favorable for surgical interference The blood examination at this time revealed white blood count 4 500 red blood count 2 500 000 hæmoglobin 45 per cent Her temperature on admission was normal pulse 78 volume poor The urine contained albumin She was prepared for operation for the

following morning and under nitrous oxide and oxygen anesthesia the large spleen was removed. It weighed 48½ ounces. Many adhesions were encountered and the bleeding gave some trouble but the patient left the operating table in good condition. The temperature rose at once to 103.5 pulse 32 but they both came down to normal in a few days. For some days the patient would have a distinct rise of temperature but the pulse remained normal or nearly so even when one of the sharp rises of temperature would indicate that she had trouble.

The blood picture after operation was interesting. The examination was by Dr. McLester.

Bl. d. c. is March 2 01 white blood count 11,000 red blood count 11,000 00 hamoglobin 45 per cent. Differential count 300 cells counted polymorphous nuclei 3 per cent small mononuclear 10 per cent large mononuclear 3 per cent neutrophils 1 per cent transitional 0.3 per cent nucleated 0.4 per cent basophils 0.3 per cent.

March 3 02 white blood count 18,000 red blood count 10,000 hamoglobin 50 per cent. Differential count 300 cells counted polymorphous nuclei 8 per cent small mononuclear 15 per cent large mononuclear 1 per cent transitional 1 per cent eosinophils 5 per cent.

April 8 19 white blood count 3,000 red blood count 3,500 000 hamoglobin 0 per cent. Differential count 500 cells counted polymorphous nuclei 86 per cent small mononuclear 1 per cent large mononuclear 1 per cent eosinophils 1 per cent.

April 5 01 white blood count 17,000

April 0 01 white blood count 0,000

The characteristic blood findings in splenic anemia are a leukopenia and anemia of the secondary type.

The patient was dismissed from the infirmary April 4 19 very much improved.

January 1913 a report from the patient was to the effect that she had gained about 3 pounds and that her health was perfect.

Pathologic report by Dr. James S. Miller: The spleen weighs 48 ounces and measures 13 by 6½ by 3 inches. Its surface is smooth and glistening and is perhaps a little darker in color than the normal spleen.

The fibrous capsule is very much thickened. The surface is very distinctly the fibrous trabeculae. Microscopic examination shows that the capsule is greatly thickened and that there is some though not marked creosote of the fibrous reticulum.

No proliferation of the endothelial cells can be noted. The malpighian bodies are smaller than usual and well preserved.

The most striking feature of the microscopic picture is the great number of eosinophiles. These cells are very frequent and are scattered evenly throughout the tissue. An average of about eight is seen to the field (section of 6 to 8 mm. corks. Winkel 3 millimeters objective and No. 3 ocular).

The great number of eosinophiles suggests Hodgkin's disease. On the other hand in clinical history the complete absence of glandular enlargement elsewhere the increase in the fibrous elements and the absence of endothelial growth point to the splenomegaly seen in Banti's disease. In the light of our knowledge I think we are forced to place this spleen in the latter class.

This case I followed for a short time as she recovered entirely but I was unable to get her to ever return to the infirmary for examination. If this case was again to be handled by me I would certainly give one or more blood transfusions but at the time this case was operated upon we were not using blood transfusion. I think it unusual in this case recovered as she was certainly a poor operation risk.

CASE 3. Female age 40. Complaint large mass in left side and general ballooning. The family history is negative. The patient has been in poor health for past five years. She had jaundice when five years old. She had hemorrhage from the blood in 04. She sleeps poorly and has lost pounds during the past year. She noticed a mass in the left side many years ago and this had continued to grow since that time. She is the mother of five children the youngest 2 years of age. She menstruates every 8 days very profusely. Upon examination she found a frailest man weighing about 100 pounds. She looks anemic and quite weak. Her chest is negative with the exception of a rattling murmur though this is fully compensated and seems to be giving no trouble.

Abdominal examination reveals a large tumor in the left hypochondriac region which could not be easily recognized as the spleen. There are enlarged glands about the body. The temperature and pulse are normal.

The blood examination shows a white blood count 6,000 red blood count 8,000 hemoglobin 30 per cent. Differential count showed small lymphocytes 3 per cent mononuclear 2 per cent polymorphous nuclei 44 per cent eosinophiles 3 per cent myelocytes 3 per cent.

The urine was negative.

The diagnosis of Banti's disease was made in this case and operation advised. Nitrous oxide and oxygen anesthesia was used and a spleen weighing 58 ounces was removed. The operation was quite easy as no adhesions were encountered and the pedicle of sufficient length to permit of its easy removal. The patient made an untroubled recovery and returned home on the fourteenth day. The report from her from time to time as she was constantly improving a good fourteen months

from the time of operation I received from her husband a letter from which I quote You will probably be interested to know that we had a  $1\frac{1}{2}$  pound boy born last night Baby and mother doing well Mrs H is enjoying better health now than she has in seven years etc

She remained in fine health until the latter part of 1917 when she committed suicide by shooting herself Cause of act unknown as she seemed well and happy

CASE 4 Male age 38 Occupation farmer and coal miner The patient complains of very large tumor in the left side The family history is negative The past history is negative except for an attack of jaundice in 1898 He has always been healthy until six years ago when he first noticed this tumor

At the present time he complains of dyspnea and palpitation of the heart He says he has spit blood several times He has lost much weight he thinks about 30 pounds during the past year

Upon examination his chest is negative There are no enlarged glands anywhere about the body A very large tumor can be felt that fills the entire abdomen but one can make out the splenic notch and it seems to be the spleen The white blood count is 2100 red blood count 282500 hemoglobin 60 polymorphonuclears 66 per cent small lymphocytes 2 per cent large lymphocytes 6 per cent basophiles 1 per cent The urine was negative

The diagnosis of Banti's disease was made and patient operated upon the following morning Cas oxygen anesthesia was used Owing to the size of the tumor and shortness of the pedicle it was quite a difficult operation Some adhesions were encountered which bled rather freely when they were severed The patient left the operating table in good condition and made an uninterrupted convalescence The spleen weighed  $13\frac{1}{2}$  pounds after all the blood was permitted to flow out

The blood from the organ weighed several pounds I think this one of the largest spleens recorded

The blood picture following operation is as follows

June 10 white blood count 16000 hemoglobin 75 per cent polymorphonuclears 4 per cent small lymphocytes 18 per cent large lymphocytes 1 per cent basophiles 1 per cent

Blood counts made daily after June 10 changed very little up to the time he was discharged from the infirmary The hemoglobin was decidedly improved and the last reading on chart was 85 per cent

This was unusual as we are supposed according to some observers to have a decided reduction in hemoglobin following splenectomy

The report on this patient at the present time is that he is in excellent health

The pathological report made by M C Winternitz is as follows

The specimen of spleen was sectioned There is no marked increase of fibrous tissue and as usual in a spleen that is greatly increased in size the malpighian corpuscles are few and small The sinusoids are everywhere distended and contain a much larger proportion of red blood cells than any other type The wall of the sinuses are definitely thickened and the endothelial cells are more prominent than usual The pulp is very cellular the cell are chiefly mononuclear in type

I do not find anything specific in the spleen to indicate a special disease and this of course is in accord with the diagnosis you have made of splenic anemia Whether this could be considered a Banti spleen is a question that is open

following morning and under nitrous oxide and oxygen anesthesia the large spleen was removed. It weighed 48 ounces. Many adhesions were encountered and the bleeding gave some trouble but the patient left the operating table in good condition. The temperature rose at once to 103.8, pulse 13, but they both came down to normal in a few days. For some days the patient would have a distinct rise of temperature but the pulse remained normal or nearly so even when one of the sharp rises of temperature would indicate that we had trouble.

The blood picture after operation was interesting. The examination was by Dr. McLeister.

*Blood counts* March 21, 91. White blood count 2000 red blood count 1,900,000 hæmoglobin 45 per cent. Differential count 500 cells counted polymorphonuclear 75 per cent small mononuclears 0 per cent large mononuclears 3 per cent eosinophiles 1 per cent transitional 3 per cent nucleated 0.4 per cent basophiles 0.3 per cent. *Mar. 29, 91* White blood count 18,000 red blood count 3,000 hæmoglobin 55 per cent. Differential count 500 cells counted polymorphonuclear 58 per cent small mononuclears 5 per cent large mononuclears 1 per cent transitional 1 per cent eosinophiles 5 per cent.

*April 8, 91* White blood count 3,000 red blood count 3,500,000 hæmoglobin 60 per cent. Differential count 500 cells counted polymorphonuclear 86 per cent small mononuclears 11 per cent nucleated mononuclear 1 per cent eosinophiles 2 per cent.

*April 15, 91* White blood count 7,000

*April 12, 91* White blood count 6,000

The characteristic blood findings in splenic anemia are a leukopenia and anemia of the secondary type.

The patient was dismissed from the infirmary April 4, 91, very much improved.

Johnny, 19, 3, a report from the patient was to the effect that she had gained about 30 pounds and that her health was perfect.

Pathologic report by Dr. James S. McLester.

The spleen weighs 48 ounces and measures 6 3/4 by 3 1/2 inches. Its surface is smooth and glitzy and is perhaps a little darker in color than the normal spleen.

The fibrous capsule is very much thickened. The cut surface shows very distinctly the fibrous trabeculae. Microscopic examination shows that the capsule is greatly thickened and that there is some thickening and marked increase of the fibrous reticulum.

No perforation of the endothelial cell can be noted. The malpighian bodies are smaller than usual and well preserved.

The most striking feature of the microscopic picture is the great number of eosinophiles. These cells are very frequent and are scattered evenly throughout the tissue. An average of about eight is seen to the field (section of 6 to 8 microns. Winkler 3 millimeter objective and No. 3 ocular).

The great number of eosinophiles suggests Hodgkin's disease. On the other hand the clinical history, the complete absence of glandular enlargement elsewhere, the increase in the fibrous elements and the absence of endothelial growth point to the splenomegaly seen in Banti's disease. In the light of our knowledge I think we are forced to place this spleen in the latter class.

This case I followed for a short time and she recovered entirely but I was unable to get her to ever return to the infirmary for examination. If this case was again to be handled by me I would certainly give one or more blood transfusions but at the time this case was operated upon we were not using blood transfusion. I think it unusual this case recovered as she was certainly a poor operation risk.

**CASE 3.** Female, age 29. Complaint large mass in left side and general bad feeling. The family history is negative. The patient has been in poor health for past five years or longer. She had jaundice when five years old. She had hæmorrhage from bowels in 1904. She sleeps poorly and has lost 18 pounds during the past year. She noticed a mass in the left side five years ago and this had continued growing since that time. She is the mother of five children the youngest years of age. She menstruates every 28 days very profusely. Upon examination we find a frail woman, weighing about 100 pounds. She looks anæmic and quite weak. Her chest is negative with the exception of a cardiac murmur though the fully competent and seems to be getting no trouble.

Abdominal examination reveals a large tumor in the left hypochondriac region which could be readily recognized as the spleen. There were no enlarged glands about the body. The temperature and pulse were normal.

The blood examination shows white blood count 6,000 red blood count 2,850,000 hæmoglobin 55 per cent. Differential count shows small lymphocytes 3 per cent mononuclears 2 per cent polymorphonuclears 44 per cent eosinophiles 3 per cent myelocytes 3 per cent.

The urine was negative.

The diagnosis of Banti's disease was made in this case and operation advised. Nitrous oxide and oxygen anesthesia was used and a spleen weighing 58 ounces was removed. The operation was quite easy as no adhesions were encountered and the pedicle was of sufficient length to permit of its easy delivery. The patient made an uninterrupted recovery and returned home on the 16th day. The report from her from time to time as to the way she was constantly improving and fourteen months

from the time of operation I received from her husband a letter from which I quote You will probably be interested to know that we had a 7½ pound boy born last night Baby and mother doing well Mrs H is enjoying better health now than she has in seven years etc

She remained in fine health until the latter part of 1917 when she committed suicide by shooting herself Cause of act unknown as she seemed well and happy

CASE 4 Male age 38 Occupation farmer and coal miner The patient complains of very large tumor in the left side The family history is negative The past history is negative except for an attack of jaundice in 1898 He has always been healthy until six years ago when he first noticed this tumor

At the present time he complains of dyspnea and palpitation of the heart He says he has spit blood several times He has lost much weight he thinks about 30 pounds during the past year

Upon examination his chest is negative There are no enlarged glands anywhere about the body A very large tumor can be felt that fills the entire abdomen but one can make out the splenic notch and it seems to be the spleen The white blood count is 2100 red blood count 285000 hemoglobin 60 polymorphonuclears 66 per cent small lymphocytes 2 per cent large lymphocytes 6 per cent basophiles 1 per cent The urine was negative

The diagnosis of Banti's disease was made and patient operated upon the following morning Gas oxygen anesthesia was used Owing to the size of the tumor and shortness of the pedicle it was quite a difficult operation Some adhesions were encountered which bled rather freely when they were severed The patient left the operating table in good condition and made an uninterrupted convalescence The spleen weighed 13½ pounds after all the blood was permitted to flow out

The blood from the organ weighed several pounds I think this one of the largest spleens recorded

The blood picture following operation is as follows

June 10 white blood count 16000 hemoglobin 75 per cent polymorphonuclears 74 per cent small lymphocytes 18 per cent large lymphocytes 7 per cent basophiles 1 per cent

Blood counts made daily after June 10 changed very little up to the time he was discharged from the infirmary The hemoglobin was decidedly improved and the last reading on chart was 85 per cent

This was unusual as we are supposed according to some observers to have a decided reduction in hemoglobin following splenectomy

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I do not find anything specific in the spleen to indicate a special disease and this of course is in accord with the diagnosis you have made of splenic anemia Whether this could be considered a Banti spleen is a question that is open



# DEPARTMENT OF TECHNIQUE

## GYNECOLOGICAL PELVIC DRAINAGE

### INDICATIONS, METHODS AND MATERIALS

B. J. WISNITSKY, M.D., F.A.C.S., W.A.

THE utility of employment of drainage in intraperitoneal pathology has been proved many hundred years ago. But it is not until a much later date that we shall not take up the relative value of drainage in gynecology. It has been established by Hyster in the eighteenth century and tube drainage though that subject is still with us. The glass tube drain through the abdominal wall was employed in practically all operations not excepting the cesarean section substituting what is now called laminectomy. But when the technique of intraperitoneal placement of foreign bodies is not difficult to understand that the surgeon is led to close the abdominal wound completely. Kelly's clinic in Johns Hopkins Hospital has established that introduction of the tube in the posterior treatment and the use of the glass intraperitoneal drainage tube was gradually established. It was used by the Mikulicz drain and that by an effort to a drainage. The question as to whether drainage should be employed or the practice of clamping and careful technique became more universal. It is a marked attention. The trend of the time since has been to avoid drainage to the utmost possible. Greater confidence in the capacity of the peritoneum to take care of its injuries has been established in our profession and notably Robert Merritt of New York have announced the preference to leave within the peritoneum found there because of its value. I am prompted at this juncture to repeat my statement to the Medical Society of Virginia in 1902 that I believe the use of pelvic drainage on never drains in clean surgery very rarely in dealing with the late result of infectious inflammation and very frequently when dealing with the processes in an early stage. But aside from the dangers of peritonitis and other evils that may arise from infectious material in the pel-

visceral cavity there is a very common and serious condition a peritoneal denudation arising from the paration of pelvic adhesion in pelvic surgery. Oftentimes the liver is covered by the pelvic peritoneum are nude and together with peritoneum is often found impossible. It is with special reference to this condition that I will consider this subject a little farther along.

I believe no one will gain as that dependency of drainage in drainage a serum pus and mucus fluid will tend to gravitate. Therefore for drainage of the female pelvis the vaginal route is always preferable to the abdominal. Nor is a station the only point of advantage of the lower route. I have not in many years seen a woman pelvis drained through the abdominal wall that I didn't think he had been unfortunate in the selection of her surgeon.

In the employment of a small drainage from the peritoneal cavity I believe it is indicated to E. P. Peabody in February 1895 after removing an ovarian tumor complicated by a cyst placed a gum elastic catheter placed into Douglas's pouch which was retained there for ten days.

Of the many materials used for pelvic drainage cotton gauze and rubber are by far the most common. Many of the rubber tubes or gauze for small areas and a combination of them for larger areas. Many favor the elastic drain of a layer of thin rubber enclosed in sterile material at gauze or rolled with the gauze. A thin rubberized paper is often substituted for the rubber. It has been claimed that such material has at times not acted as a drain but in an opposite way i.e. plugged the opening into the vagina and caused an accumulation of fluid above them that found an exit through the abdominal wound thus venous or possibly infecting it. In 1910 I exhibited to the American Medical Association

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a rubber drum I had devised and employed for several years in pelvic vaginal drainage. It consisted of a triangular piece of thin rubber usually taken from a condemned rubber glove and attached by its narrow base to a soft rubber round rod about  $\frac{1}{4}$  inch in diameter and two and a half inches in length. This bar was made to rest on the uterosacral ligaments and the thin rubber about 4 inches in length protruded into the vagina. The lowest angle of it could be grasped with a forceps introduced through the vulva and the whole of the drain easily and painlessly with drawn. Ofttimes plain gauze was brought down behind it when extra covering of denuded peritoneal areas was desired. Until March 1916 when I began the use of the paraffine stearine gauze for this purpose the rubber drum was used with a high degree of satisfaction though at times its withdrawal was notably painful to the patient.

Hart I. Fisher<sup>1</sup> used plain surgical gauze, surgical cotton, chamois skin, gutta serena tissue, silver foil, paraffine or oiled paper, rubber dam (dental), narrow mesh fine silver wire screen, medicated gauze dressing, cold cream and powder dressing and he concluded that plain gauze soaked in equal part of stearine and paraffine was perfect in its non adhesive property and could be placed against the denuded tissue and covered with other (plain) gauze to absorb discharges coming through the special gauze without adhesion of the dressing to the wound.

In cases in which in the course of several days the plain gauze was several times changed without disturbing the paraffine stearine gauze, no adhesion occurred.

His method of preparing this gauze follows:

Paraffine is brought to the boiling point at three different intervals in the course of an hour and filterd through a narrow lyne hedg ue. It is then sterilized and freed from any foreign bodies such as minute particles of dirt.

During this procedure the stearine (stearic acid) is brought to the boiling point and filterd by the same process and for the same number of times. The equal parts of the liquid hot paraffine and liquid stearic acid are poured into a white porcelain container again brought to the boiling point and filterd as described above. The mixture then ready for the use of the medicated gauze is in such a suit which is numbered in it for ten minutes to allow the gauze to become thoroughly impregnated with the fluid. The gauze is then removed and stretched and the excess of mixture allowed to drain off. A jet of filtered and heated air is directed against the gauze drying the film of wax on the meshes to melt and allowing a more uniform result. When dried the gauze is placed in a sterile container and sealed.

I have had this gauze made by this formula and have the feature of blowing hot filtered

air through has been omitted thus avoiding a very troublesome feature and as well a possible danger of contamination. The product of the curried process was not as smooth though by breaking it slightly when applying it no practical defect has been noticed. The pieces should be originally cut small as often but small areas are to be covered and the difficulty in making this gauze would emphasize the necessity of greater economy in its application. Paraffined honeycomb dressing prepared by one commercial laboratory is stiffer and coarser meshed. I have used it but the meshes are too large. However it is a fair substitute for Fisher's paraffine stearine gauze.

For two and a half years since reading Fisher's article I have been using Fisher's gauze for vaginal drainage from the pelvic peritoneum. It has been used largely as a casing of one or two layers surrounding plain gauze. I soon learned to suture the casing to the core of plain gauze. For in one patient the interne Dr Kane removed 8 inches of the 4 inches of gauze on each of the third, fourth and fifth postoperative days. To our surprise 3 days later the patient expelled the 4 inches of the paraffine stearine gauze.

In a fair proportion of the work a roll of the latter gauze was used without the plain gauze core. The employment of this material for pelvic peritoneal drainage has been so satisfactory that I have adopted it to the exclusion of all other materials for this purpose. In one instance the interne was about to remove one third of a strip of this material 24 inches in length on the third day after operation from a very nervous patient. Becoming greatly excited she strained and expelled in a serpentine shape the whole of it before he could get hold of it or get her to desist from straining. These two instances tend to confirm the statement that it does not adhere to the tissues.

On applying this gauze it will be thought its rigidity renders it inappropriate but the temperature of the body readily softens the material causing it to mold itself as smoothly as plain gauze. This gauze then I feel may be relied upon to protect denuded pelvic peritoneum for a sufficiently long period of time for endothelialization under it to occur thus avoiding the much dreaded adhesions of intestine and omentum to such denuded areas also while affording disposal of any accumulated fluids may also be itself removed at any elected time.

I may add I have had opportunity to view several months subsequently a few of the pelvis thus drained and in none of them were pelvic adhesions present.

# DEPARTMENT OF TECHNIQUE

## GYNCOLOGICAL PELVIC DRAINAGE

### INDICATIONS METHODS AND MATERIALS

J. J. WISLIA BOVET M.D. IACS WASH.

THE subject of employment of drainage in intraperitoneal pelvic surgery has provoked many heated discussions lately but much activity has not taken up the relative value of capillary drainage (aid to haemorrhage) as suggested by H. J. R. in the nineteenth century and tube drainage though that subject is not without interest. The glass tube drain though the old method would be employed in practically all operations (excepting the con-  
 lition of the uterus) that are now called clean ones. But when we review the technique of intraperitoneal operation forty years ago it is not difficult to understand that the use of drainage to do the abdominal work completely. Kelly, Clin. in John Hopkin Hospital has said that infection is introduced through the tube in the postoperative treatment and the use of the glass intraperitoneal drainage tube was gradually neglected. It was suggested by the Mikulicz drain in an effort to avoid drainage. The question is to whether drainage should be employed as the practice of cleanliness and careful technique became more universal, we can mark attention. The trend of the time since has been to avoid drainage to the utmost degree possible. Greater confidence in the capacity of the peritoneum to care for its injuries has been established in our profession and more recently R. L. M. of New York have an opinion that it is preferable to leave within the peritoneum found there because of its food value. I am prompted at this juncture to repeat my statement to the Medical Society of Virginia in 1901 that I believe the wise pelvic surgeon never drains in clean surgery very rarely in dealing with the late results of infectious inflammation and very frequently when dealing with the process in an early stage. But aside from the danger of peritonitis and other evil that may arise from infectious material in the pel-

vic portion of the peritoneal cavity there is a very common and serious condition a peritoneal denudation arising from the separation of pelvic adhesions in pelvic surgery. Oftentimes quite large areas of the pelvic peritoneum are denuded and to cover them with peritoneum is often found impossible. It is with special reference to this condition that I will consider this subject a little further along.

I believe no one will gain by that dependency is advantageous in drainage a serum pump and most fluid will tend to gravitate. Therefore for drainage of the female pelvis the vaginal route is always preferable to the abdominal. Nor is gravitation the only point of advantage of the lower route. I have not in many years seen a woman's pelvis drained through the abdominal wall that I did not think she had been unfortunate in the election of her surgeon.

For the employment of vaginal drainage from the peritoneal cavity I believe we are indebted to J. I. Peake who in February 1855 after removing an ovarian tumor complicated by a cyst placed a gum elastic catheter *per vaginam* into Douglas pouch which was retained thirteen days.

Of the many materials used for pelvic drainage cotton gauze and rubber are by far the most commonly employed the rubber tube or gauze for small areas and a combination of them for larger areas. Many favor the cigarette drain of a layer of thin rubber enclosing tar or medicated gauze or rolled with the gauze. A thin rubberized paper is often substituted for the rubber. It has been claimed that such material have at times not acted as a drain but in an opposite way i.e. plugged the opening into the vagina and caused an accumulation of fluid above them that found an exit through the abdominal wound thus causing an impossible infection. In 1901 I exhibited to the American Medical Association

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In cases in which in the course of several days the plain gauze was several times changed without disturbing the paraffine stearine gauze no adhesion occurred.

His method of preparing this gauze follows:

Paraffine was brought to the boiling point at three different intervals in the course of an hour and filter through a narrowly meshed gauze. It is thus filtered and freed from any foreign bodies such as small bits of grit etc.

During this procedure the tar (stearine) is brought to the boiling point and filtered by the same process and for the same number of times. Then equal parts of the liquid hot paraffine and liquid hot stearine are poured into a white porcelain container again brought to the boiling point and filtered as described above. The mixture is then ready for the sterile use. The meshed gauze cut in size to suit is immersed in it for ten minutes to allow the gauze to become thoroughly impregnated with the mixture. The gauze is then removed and stretched and the excess of mixture allowed to drain off. It is then filtered and heated in a dedicated gauze. The film of wax over the mesh is melted and allowed to become uniform over the screen. When desired the gauze is placed in a sterile container and sealed.

I have had this gauze made by this formula and again the feature of blowing hot filtered

air through has been omitted thus avoiding a very troublesome feature and as well a possible danger of contamination. The product of the curried process was not as smooth though by breaking it slightly when applying it no practical defect has been noticed. The pieces should be originally cut small as often but small areas are to be covered and the difficulty in making this gauze would emphasize the necessity of greater economy in its application. Paraffined lace made dressing prepared by one commercial laboratory is stiffer and coarser meshed. I have used it but the meshes are too large. However it is a fair substitute for Fisher's paraffine stearine gauze.

For two and a half years since reading Fisher's article I have been using Fisher's gauze for vaginal drainage from the pelvic peritoneum. It has been used largely as a covering of one or two layers surrounding plain gauze. I soon learned to suture the casing to the core of plain gauze for in one patient the interne Dr Kane removed 8 inches of the 4 inches of gauze on each of the third fourth and fifth postoperative days. To our surprise 3 days later the patient expelled the 4 inches of the paraffine stearine gauze.

In a fair proportion of the work a roll of the latter gauze was used without the plain gauze core. The employment of this material for pelvic peritoneal drainage has been so satisfactory that I have adopted it to the exclusion of all other materials for this purpose. In one instance the interne was about to remove one third of a strip of the material 24 inches in length on the third day after operation from a very nervous patient. Becoming greatly excited she strained and expelled in a serpentine shape the whole of it before he could get hold of it or get her to desist from straining. These two instances tend to confirm the statement that it does not adhere to the tissues.

On applying this gauze it will be thought its rigidity renders it inappropriate but the temperature of the body readily softens the material causing it to mold itself as smoothly as plain gauze. This gauze then I feel may be relied upon to protect denuded pelvic peritoneum for a sufficiently long period of time for endothelialization under it to occur thus avoiding the much dreaded adhesions of intestine and omentum to such denuded areas also while affording disposal of any accumulated fluids may also be itself removed at any elected time.

I may add I have had opportunity to view several months subsequently a few of the pelvis thus drained and in none of them were pelvic adhesions present.



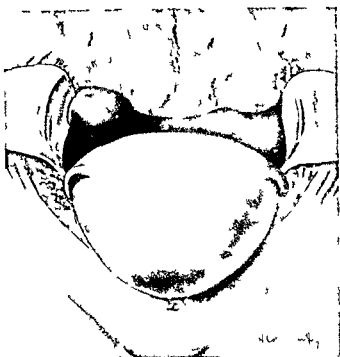


Fig. 1. Case 2. Showing enlargement of uterus and elevation of fibroid. The fibroid is some what retracted in this drawing as it really did not appear above the surface.

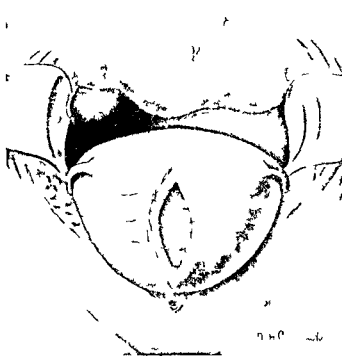


Fig. 2. Case 2. Showing tumor removed by elliptical incision and uterus in rapid approximation introduced.

view of the fact that the patient was contemplating matrimony and on account of her earnestly expressed wish not to have any of her organs removed it was determined to resect the affected portion of the uterus instead of performing a hysterectomy. This was further indicated because it was deemed advisable to clear up the pathology by securing the affected portion of the uterus for microscopic study. The resection was done by making a double V incision on the endometrium as far as the internal os anteriorly and posteriorly. The endometrium was found to be very much thickened and fungous. This was curetted through the incision. The lateral portions of the uterus that were left were sutured to each other with interrupted sutures of Lagenstecher. The patient made an excellent recovery and was subsequently married and became pregnant. She however aborted at about four and half months. A year later she became pregnant again but aborted at the end of one month. However in July 1915 five years after the operation she was delivered of a full term infant with no pathological evidence during the pregnancy or at time of birth.

CASE. Reuter No. 2550. The patient is a young woman aged 40 years, white female, single. She gave the following history. She sought relief for her flow of blood for many years. Her menstrual periods came at fourteen years and at first she had no trouble. The tendency to go on for time and a very light discharge. Her period had always been free and would last for five days. At three or four years later she began to suffer with endometritis and a year later she had a uterine attack. In the next year she had a miscarriage. She said that she had had many children, but her menstrual periods were usually normal. She was finally operated upon in the year 1910. About a year previous to the time she consulted me. About six hours after the operation the flow came on which was at the uterine and after a

considerable pain in the lower abdomen. After leaving the hospital she suffered with more pain at the time of her period and the flow increased. Eight months previous to consulting me she had had a continuous flow for about a month and had been taken to the hospital and curetted. This however did not afford any relief and she continued with an irregular flow which at times was very profuse. On entering the hospital she presented every appearance of a person suffering from profound anemia. On examination her abdomen was negative. On bimanual examination the fundus of the uterus was found retroverted but not irregularity in the contour of the uterus could be detected. In view of the fact that the patient had been curetted without relief it was determined to perform a laparotomy and to explore the uterus through an incision.

When the uterus was brought up a fibroid nodule could be palpated in the anterior wall which was evidently extending to the cavity of the uterus. The tumor was removed by making a free elliptical incision and a submucous fibroid nodule about the size of a walnut was removed. The endometrium was thickened and fungous and was thoroughly curetted through the incision. The opening was then closed with Lagenstecher sutures and the dissection was completed by performing the Webster-Baldy operation. The patient was entirely relieved of all her symptoms and in no way excelled in health. In a letter just received she says she has gained in weight and feels well and enjoys practically no pain in the period.

Reoperation offered the only satisfactory method of dealing with this case. In the first place the exact pathology would have had to be a matter of conjecture unless the uterus were examined by direct inspection and palpation as the tumor presented on the interior of the uterus and its detection by bimanual examination was practically impossible as the only sign elicited was a

slight enlargement. But even though the diagnosis were carried out removal by the genital route in a virgin would have been attended with the greatest difficulty and danger.

#### INDICATIONS

As to the indication for this operation we approach it from two points of view. First indication of the uterus to expose the cavity. This presents a comparatively wide field of usefulness. We have to admit that even after making the most painstaking examination we are not infrequently in doubt as to the exact path to follow. In a case of doubt it is a very careful and laborious to incise the uterus and inspect and palpate the cavity directly and this is certainly indicated here the alternative proposition will be the removal of the uterus and the subsequent study of the path to follow. The point in other words is clearly brought out in Dwyer's paper on Anterior Transperitoneal Hysterotomy.

Second resection and reconstruction of the uterus. We must admit that the application of this procedure is necessarily limited. However in certain conditions it would appear to be clearly indicated in preference to removal of submucous fibroid that are still within the cavity of the uterus and also in preference to myomectomy provided the tumor lie in such a way that they can all be removed by resection. In young unmarried women and in married women who have not had children we would be justified in resorting to this operation in preference to hysterectomy even though it entails the risk of another operation on account of fibroid that may develop. Every case here of course to be judged on its merit and perhaps not many will arise in which we can practice this method. Certainly I have found this so in my own practice. But by study of the anatomy and pathology with the uterus in the hand and under the eye it is possible in some cases to cure very gratifying results.

## THE USE OF CONTINUED EXTENSION BY MEANS OF A NEW EXTENSION TRAMP IN THE BLOODLESS REDUCTION OF CONGENITAL DISLOCATION OF THE HIP

By JOHN W. CHURCHMAN, M.D., IACSS, N.Y.  
 (Continued from page 547)

In the pull-traction continuous dislocation of the hip, Lorenz described a completely new pathology of the condition and indicated a new method technique to be used in its treatment that this chapter of surgery might be regarded as closed. So excellent were the results of his method in his own hand that since his time under the limitations of directly effect for the procedure by Lorenz himself bloodless reduction has been considered the difficult to be met — one of the most successful of surgical procedures. According to Lorenz's own figures 56 per cent of 680 cases were cured extraordinarily good results for an extraordinarily bad deformity. In spite of the effect the method of bloodless reduction is not without its drawbacks. The impression of brutality made when one witnesses for the first time a hip thus reduced is a thing not soon forgotten. The formation of ulcerateous hematomata from manipulation is serious enough to result in rupture of structure and indeed the indication of a treatment of the tissue is violent a

to be not without its danger. The dangers were fully appreciated by Lorenz himself and are described in his monograph. The first of the dangers is a death rate from anæsthesia associated with the violence of the manipulation under the anæsthetic and his method could be eliminated by the anæsthetic alone. The fact of itself is sufficient cause for dreading to do away with forced manipulation if equally good results can be obtained without it. But in addition to the occasional death from this cause Lorenz calls attention to a number of other accidents which have resulted from the forcible manipulation necessary in bloodless reduction. In the 450 cases which he reviewed the following complicating accidents occurred:

|   |   |   |   |   |    |    |   |   |
|---|---|---|---|---|----|----|---|---|
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| F | t | f | t | p | k  |    |   |   |
| P |   | t | p | l | y  | (t | m | p |
| C |   | t | p | l | y  | (t | m | p |
| S | t | p | l | y | (t | m  | p | t |
| R | i | t | f | t | f  | m  | l | t |
| C |   |   |   |   |    |    |   |   |

The modification of the Lorenz technique which I wish to suggest in this paper and to illustrate by a case recently treated aims to eliminate the risks while adhering to the principle of the technique and to do this by substituting for the violent manipulations under anesthesia a rather gradual extension. I am perfectly well aware that methods of continuous extension have been previously employed but as I have tried to make clear in the title of this article my own suggestion is not to *replace* the Lorenz method by a method of continuous extension but simply to *substitute* for the purely manipulative procedure of Lorenz the gradual method of continuous extension. For this purpose a new type of extension frame has been devised and by its use it has been possible to do what I have never hitherto accomplished, namely to put extension on the leg in any desired position of abduction and at the same time to keep up any desired type of rotation. By use of this frame the position of the leg so far as abduction or adduction is concerned may be changed at will and when so changed the straps which are maintaining rotation may also be readily and instantly changed. We have found that by using this type of extension frame the muscles may be stretched gradually just as in the Lorenz method they are stretched suddenly to any desired degree and absolutely without pain and that the head of the femur may be gradually laid into the position desired purely by the method of extension and rotation or by the *ele* method

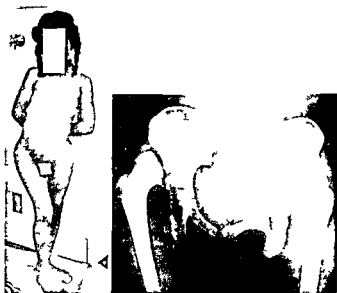


Fig. 1 Deformity presented on admission.  
Fig. 2 Position of femoral head on admission.

supplemented by the slightest possible manipulation of the head of the femur.

The reduction of the dislocation having been brought about in the manner described the case must be handled exactly as indicated by Lorenz for it is an error to imagine that the Lorenz method of hip reduction consists only in manipulative procedure and does not include the fixation of the reduced femur in such fashion as to lead to pressure of the femur on the acetabulum by supporting the body weight. It should therefore

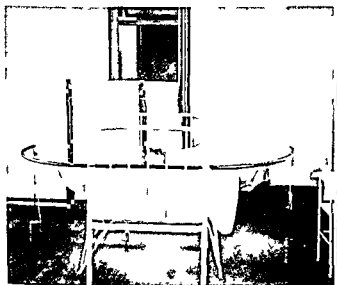


Fig. 3 Extension frame applied to foot of bed, legs abducted to form with each other an angle of practically 90°. The pulleys carry the weight of the legs and attach close to the ends of the extension frame (position December 7 see diagram Fig. 13).

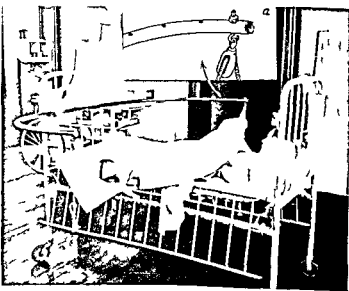
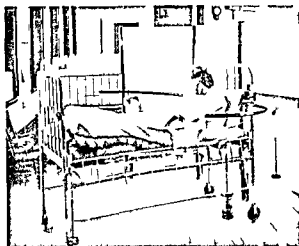
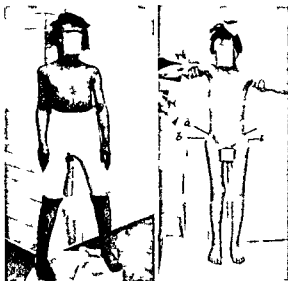


Fig. 4 Late view of apparatus. The small diagram shows a detail of the end of the extension frame to illustrate the manner in which the extension pulley is attached to the frame.





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 P t l l t t th f l m t t t k i  
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 l f t l k m k d t l t t



I k ( t f f ) D k f f t h h p l t  
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hardly be necessary to say that the method of treatment here suggested does not make the blood reduction of hip a method applicable to cases which are not also suitable for the Lorenz method. Both methods are subject to the same condition though it is possible that a few cases which cannot be reduced by manipulation in the sitting may yield to the gradual firm treatment. The limitations of the bloodless method of reduction were clearly under to demonstrate Lorenz and his made it plain that in a large group of cases particularly after the eighth year a cure in the anatomical sense could not be obtained and that only anterior transposition could be hoped for.

The patient referred to in this article was a rather poor case in which the transposition of

treatment for he was eight years old at the age that it is to say when the chance of successful treatment is doubtful. In addition to this the acetabula were so shallow that it seemed unlikely that we would be able to hold the femora in position even if we could get them there. What I hoped to do was to bring the head of the bone into their normal position and then by an operation to enlarge the acetabula. The parent of the child refused to give permission for the operation and we have therefore had to do it along with practically no acetabula. We are able however to demonstrate on this patient that the head of the femur can in a relatively unfavorable case of this sort can by means of the extension method to be presently described be put at will in practically any position one wishes.



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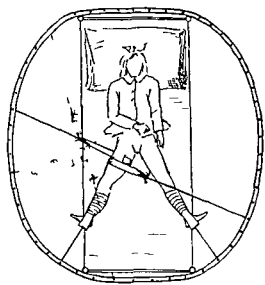


Fig 12 Extension frame viewed from above showing extension and rotation straps applied with leg in two different positions

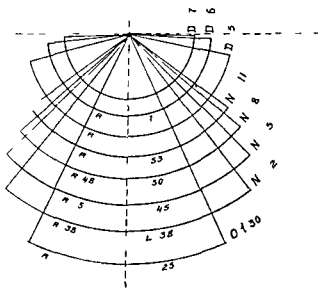


Fig 13 Diagram showing progress of abduction of the leg

We kept accurate control of the position of the head by repeated roentgenographs and found that any change of position indicated by these plates as necessary could be readily obtained by changing the direction of the pull of extension or rotation straps. We also demonstrated the value of the extension frame in handling any case where extension and rotation were to be applied to a limb at the same time.

The deformity in this patient was typical of a double congenital dislocation as is shown in Figure 1. The position of the heads in relation to the acetabula is shown in Figure 2 in which it will be seen that on the left side there is a marked anteversion of the neck, probably about 45°, a fact which annoyed us a great deal in handling the case. This degree of anteversion is indeed according to Durham a strong if not an insuperable obstacle to the reduction of the deformity.

The extension frame used consisted of a 1½ inch gas pipe bent into a semicircle. It was perforated at intervals of about two inches with a series of holes for the reception of pins to which were attached pulleys for the weights; these pins were fastened to the frame by nuts and could be in this way placed in any of the holes desired (See Fig 4). The use of the extension frame when attached to the foot of the bed is shown in Figures 3 and 4. If abduction beyond a right angle was desired or if it was found that with abduction nearly at a right angle the child overcame this abduction by rising in bed the extension frame was shifted to the head of the bed as shown in Figures 5. In this position abduction to any desired degree could be obtained. For the

production of rotation straps were attached in the usual fashion and these were led to pulleys which could be attached at any point in the frame desired. This description refers to the form of the extension frame which I first used. In its present very satisfactory form it is used as shown in Figure 12 where the frame completely surrounds the bed and as one can see at a glance from the diagram a leg can instantly be put in any position of abduction or rotation. The nursing care of the child may be carried on by having the nurse step within the frame.

By means of an apparatus of this sort the angle of abduction of the two legs in the patient here described was gradually increased from October 30 to December 7 as shown in Figure 13. Starting with an angle of 50° we reached by December 7 as will be seen an angle of practically 180°. During this procedure accurate control of the position of the head of the femur was kept by means of roentgenographs and the rotation straps thus indicated as necessary were kept constantly applied. As was to be expected the anteversion of the left femur gave us a good deal of annoyance but I was surprised to find how readily the rotation could be overcome by the continued pull of rotating straps and also to find that when this rotation was finally overcome it seemed to be permanently overcome. It is probably unnecessary to devote so much time as was done in this case to obtaining the degree of right angle abduction required. As we had no experience to go on we proceeded very slowly but it became evident later that this was an unnecessary waste of time.

A few X ray picture taken for control are reproduced to show the progress of the case. The original position is seen in Figure 2. Figure 8 shows abduction begun. Figure 9 shows abduction completed, the right hip is now opposite the normal acetabulum, the left hip still opposite the abnormal acetabulum and in marked position of anteversion. At this stage the patient was given a whiff of chloroform in her bed and without any difficulty whatever the head of the left femur by the lightest possible manipulation was slipped into its proper position. In Figure 10 both heads are shown in their normal position, the dislocation has been reduced and the anteversion of the left hip has been overcome. At this stage it necessary to begin to reduce the abduction by moving the extension pins on the frame toward the mid line and to bring the leg gradually into such position that when the plaster cast is applied the child may be allowed to walk and thus to transmit the body weight through the head of the femur to the acetabula. In Figure 11 the abduction has been in this way to a large extent reduced. It will be seen that the material with which the acetabula are doubtless filled (this was a point which Lorenz brought out in his study of pathological specimen of this condition) has pried the head of the bones out and the position is not quite so good as in Figure 10. Undoubtedly operative intervention at this point was indicated in order to hollow out the acetabula but permission for such intervention was refused by the parent. The position of the hips at this time in the plaster cast and a few days later when the plaster cast was removed

is shown in Figure 6 and 7. In Figure 7 the anterior superior spines and the great trochanters have been marked *a* and *b* and it is seen that a fairly good anatomical result with an excellent cosmetic result has been obtained.

The method here described consists briefly in:

- 1 Application of extension in the lines of the legs as they rest in their deformed position.
  - 2 Gradual abduction until the legs form with each other an angle of 180°.
  - 3 When maximum abduction has been produced digital manipulation of the head of the femurs to drop them into place.
  - 4 Maintenance throughout of rotation necessary to keep the toes pointing directly upward.
  - 5 Gradual reduction of the maximum abduction produced until the legs form with each other an angle of about 35°.
  - 6 Application of plaster cast from the waist to the knees.
  - 7 Transmission of the body weight to the acetabula through the head of the femurs by allowing the child to walk.
- If a favorable case in a young infant with well developed acetabula treated in this way not only will the case be simplified by eliminating the violent manipulation hitherto used but more accurate results will probably be obtained because it will be found that the head can in this way be placed exactly where one wishes it to be and that if the position is by roentgenographs shown to be not entirely satisfactory a change in the direction of the extension or rotation straps will make the desired correction.

## A GAUZI SPONGE SPONTANEOUSLY EXPELLED FROM THE URINARY BLADDER

BY G. LAUL ROQUEMONT, FACCS, RICHMOND, VIRG.

THE case herewith reported is interesting clinically from the standpoint of painful spasm of the bladder due to the urine and a palpable mass in the right side of the pelvis academically because of its rarity and practically interesting from several standpoints.

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B. l. m. r. d. m. b. e. s.

Ten days before admission quite suddenly and without apparent cause she was seized with a frequent desire to urinate. She had considerable pain before, during, and after urination constant pain in the lower abdomen. The urine was foul and contained considerable sediment and was passed a little at a time at intervals of one half to one hour night and day. She sought relief immediately and Dr. W. after applying the usual remedies without improvement brought her in for examination and treatment.

During the night on her trip to the hospital two large doses of morphine and hyoscine had to be administered on account of tenesmus. Upon admission to the hospital the pain was agonizing, the foul odor and frequency of urination were equally embarrassing to her refined and modest temperament. In spite of her fortitude she exhibited a distressing appearance. Her temperature was normal, pulse 90. A thorough examination of her entire body revealed no evidence of disease except in the pelvis and a slight amount of tenderness in the right lumbar region.

Vaginal examination showed tenderness most marked in the region of the bladder. The uterus was in normal position and freely movable. In the right vaginal fornix a distinct mass was palpable and quite tender. Examination of a catheterized specimen of urine showed it to be three-fourths pus. Examination of a filtered specimen showed it to be acid in reaction containing an abundance of albumin, pus and blood but no casts or other renal element. The urine was dribbling away constantly could not be retained and every half hour or so coincident with a pain in the bladder she would expel sometimes as much as three or four ounces. X-ray examination made the next day showed a slight enlargement of the right kidney, a normal left kidney and a vague diffuse shadow in the true pelvis. No stone was present in any part of the urinary tract and there was nothing characteristic about the shadow in the pelvis. Dr. A. L. Gray, the roentgenologist was quite satisfied when he saw a specimen of the pus containing urine that this in the bladder could easily account for the shadow in the pelvis. Her temperature the next day was 101, pulse 100. There was at no time any evidence of kidney colic nor kidney tenderness.

At this point we were quite puzzled. The mass felt in the right vaginal fornix of course felt quite like an enlarged ovary or tube. We frequently see pus in urine in cases of inflammation of a tube and ovary though I have never seen such pus containing urine as this caused by such pathology. Moreover she had no vaginal discharge nor menstrual symptoms indicative of disease of the uterus, tubes or ovaries. I tried for two or three days to urge myself into making a cystoscopic examination but the agonizing pain which the woman suffered at all times and especially whenever her bladder contained as much as two or three ounces caused me to believe it could not have been made without a general anesthetic and I continued to postpone it from day to day. With the usual drugs directed to the relief of vesical tenesmus no relief was obtained and even with morphine sometimes combined with atropin and with hyoscine there was no relief for more than a few hours. Several vaginal examinations revealed the same mass in the right fornix. We were genuinely puzzled as to whether to do vaginal cystotomy or to operate upon the abdomen and temporized from day to day. Four days after she came to the hospital she suffered retention of urine and an unsuccessful attempt was made by the nurse to catheterize her. I noticed my self in using the soft rubber catheter that it had to be introduced about three inches before urine came. I introduced a quart of foul pus containing urine. She continued to suffer the same tenesmus passing the same kind of urine though at no time was her temperature above 101 and her pulse ranged from 80 to 110.



Fig. 1. A gauze sponge 2 inches wide by 10 inches long was spontaneously expelled from the urinary bladder.

Five days later the aim had retention and an unsuccessful attempt was made by a nurse to catheterize her. Upon inspection of the meatus I noted a white substance close examination of which revealed a piece of gauze in the urethra. Twisting this into a rope with my fingers the gauze 2 inches wide and ten inches long here exhibited as removed. Within 12 hours her symptoms were distinctly improved and from day to day the improvement was rapid. In six days she was apparently well she had no urinary symptoms of any kind and the urine was clear. Microscopic examination showed only a small quantity of pus. She was walking about and enjoying life as usual. In the meantime a perfectly normal menstrual period had appeared lasted four days and ceased. Five days after removing the sponge a cystoscopic examination painlessly made showed no evidence of any foreign material in the bladder and no stricture. The only evidence that the bladder had ever been diseased was shown by a small area to the left of the right ureteral orifice which looked like an almost healed fistula. No mass or other evidence of disease could be detected by vaginal examination. One week after the gauze was removed and three weeks after coming to the hospital she returned to her home a perfectly well woman and has remained well ever since.

#### SUMMARY

1. A clean small gauze sponge was left in a clean pelvis.
2. No symptoms of any kind resulted during an after period of five years.
3. Sudden apparently causeless onset of bladder tenesmus and suppurative was followed in three weeks by spontaneous expulsion of the sponge to the meatus and easy delivery was accomplished by traction with the fingers.
4. Instant relief of tenesmus and rapid and complete subsidence of all symptoms and in a week spontaneous closure of the fistula through which the gauze had ulcerated into the bladder.



The stone a large one resembles a monkey wrench. Her urine was examined microscopically since the operation but contained no blood. The patient left the hospital the third week.

#### DISCUSSION

DR ARTHUR DEAN BEVAN I have had but a limited experience in handling cases of papilloma of the large intestine. Dr Frank has referred to a case of which I recently reported in the *Surgical Clinics of Chicago*. That was a single papilloma in the sigmoid and it interested me more from the standpoint of diagnosis than from anything else. I am glad Dr Sippy is here because it was his diagnosis which to my mind made the case particularly interesting.

I went to the hospital one morning and Dr Sippy wanted me to remove a papilloma from the middle of the sigmoid. I asked him if he had seen it with the proctoscope and he said he had not, that the diagnosis had been made definitely from a careful analysis of the clinical findings. This woman had for a long time blood in the stool. The blood was not evenly intermixed with the stool but was blood that would come in clots and as I remember from the careful analysis which he made, he limited it to that portion of the bowel in which hardened fecal matter is first formed and he therefore made the diagnosis of polypus of the sigmoid excluding definitely on account of its long standing carcinoma.

I made a laparotomy at his suggestion, picked up the sigmoid ran it through my fingers and could not find anything at first but finally stripping it back and forth I found a good sized polypus about the size of the end of my thumb with a long pedicle. It was easily removed. It was a single polypus and after its removal the hemorrhage ceased entirely.

Multiple polypi I have seen several times. I have one case of polypus which produced invagination of the transverse colon. I operated on this case and it presented a very interesting picture. Multiple polypi of the colon present a very serious lesion for the patient because many of these cases terminate fatally. Quite a number of patients live long enough for these polypi to become carcinomatous hence they are among the most serious lesions of the large bowel.

DR A. J. OCHSNER I would like to call attention to a method that I have used for disposing of these large intestinal polypi. The method consists in slitting open the intestine putting a clamp at the base of the polypus and excising it with the cautery as one would remove a polypus in the rectum through a proctoscope. The wound in the intestine is then closed. I have tried this method and it works well.

DR CARL B. DAVIS A year or more ago a patient that came under my observation was passing blood in the stools at irregular intervals. We made an examination with the proctoscope but were unable to make a definite diagnosis. We could find nothing. We opened the abdomen and found the ascending transverse and descending colon studded with polypi. There was hardly any place that was not covered with these polypi. The bowel was not removed. The patient still has polypi of the ascending transverse and descending colon; there are probably several hundred in that area. The patient is a man 35 years of age.

DR EMIL G. BECK read a paper entitled "A Simple Method of Arresting Tuberculous Spondylitis with Demonstrations of Patients and Radiograms."

#### REGULAR MEETING JANUARY 1919 WITH DR THOMAS J. SULLIVAN PRESIDING

##### OSTEOMYELITIS OF THE CLAVICLE

DR CARL B. DAVIS A year ago this man was struck by an automobile and developed an osteomyelitis of the clavicle which was treated from time to time and the condition finally subsided leaving him unable to raise the arm. The deltoid muscle has been detached from its clavicular region and has slipped down into the arm. An incision was made parallel with the clavicle below the line of the old scar. A second incision at right angles was carried down over the top of the shoulder until the deltoid was exposed to view. The muscle was found retracted to about one half its length. A fascial flap was taken from the thigh with a thick layer of subcutaneous fat adherent. The flap was sewed over the shoulder joint and with the fatty surface down to avoid adhesion of the fascia to the underlying structures. The upper end of the fascia was attached to the trapezius and clavicle. The arm was elevated to as high a point as we could get it. The deltoid pulled up and stitched into the fascia with chromic gut. At the completion of the suture the deltoid did not

reach to the clavicular level by three quarters of an inch. The cast was adjusted with the arm in complete abduction. The man has been out of the cast for a week and it is gratifying to see the amount of motion he has already. We have started him on wand exercises hoping to speed the function.

NOTE.—On checking over these notes one month later we might state that the man is able to lift his arm to a horizontal position.

#### DISCUSSION

DR CARL BECK The case of fascial plastic is very interesting first because the fascia healed in without reaction and second because the patient has a good functional result. This result will improve in the course of time. Unfortunately, fascia is not used as often as it should be in plastic work and most of the men who use it do so without the use of fat. Fat is a splendid lubricant especially when the fascia is used to wrap tissues to protect tendons or nerves that adhere by cicatricial tissue.

# ARTERIOVENOUS ANEURISM AFFECTING THE BRACHIAL PLEXUS

DR LAWRENCE RYAN reported a case of arteriovenous aneurism affecting the brachial plexus.

E. T. Llan male age 75 unmarried occupation tchman has always been all a strong He has had occasional nocturia but no venereal infection He drinks line with meals uses very little tobacco He keeps good hours and eats and sleeps normally On August 5 1906 while on duty as a tchman he was shot the bullet entering the chest at the lower angle of the scapula on the right side The bullet did not leave the body He talked about it and fell unconscious Profuse hemoptysis occurred Several hours later he regained consciousness His right arm was completely paralyzed By December 9 1906 he had good use of his arm and partial use of the forearm The hand remained almost useless By December 13 1906 there has been improvement in the hand On August 9 1906 the right pleural cavity was opened and drained The empyema healed up rapidly On September 16 1906 an attempt was made to remove the bullet but without success In December 1906 a second attempt was made to remove the bullet by another surgeon but again without success These operations were performed in Lenox Hill Hospital On September 1906 a right-sided tunstutium made the patient very uncomfortable He then noticed a mark of the bullet in his neck on the right side

Examination revealed a well-nourished man weighing 130 pounds 5 feet 6 inches tall Thin and muscular No dryness of the skin No pigmentation present There are marked distended veins on the neck and head—possibly not abnormal The right external jugular vein becomes greatly enlarged on compression above the clavicle The right pupil smaller than the left Both exact light and accommodation The fundi show no abnormal elements update hemorrhage There are signs of previous operations in the cervical region

A definite contour of the vessels on the right side of the neck The purring sound is continuous and can be identified with the heart beat It appears somewhat more marked on systole The tethers of the tongue is clear presents no tenderness and does not irritate The throat and nose are clear The chest is well developed there is no change of respiration to expiration There are two scars one in the right pectoral area and one at the angle of the right scapula There is no abnormal tactile or vocal fremitus Breath is clear bronchial sounds are normal throughout The ears are normal The heart shows no enlargement The sounds are clear and peaceful The cardiac function is normal test shows no alteration in rhythm and gives a good return to normal The heart muscle is thickened endocardium is normal The pulse is even and compressible The abdomen is normal The liver edge is felt at the umbilicus The kidneys and

spleen are not palpable There are no prominent veins The abdominal reflex is normal The inguinal and anal empty and the rings normal There are no bean-sized glands here The genital are normal there are no scars and no urethral discharge The scrotal reflex is present The prostate is normal like the rectum The extremities are normal except the right arm There is no clubbing of the fingers scars of amputation or ordema The reflexes are normal Muscular tone and skin sensation normal

The osseous and glandular systems show no changes

The temperature is 98.6 pulse 72 blood pressure 100 diastolic 70

Blood hemoglobin 90 per cent (Tallquist) oxygen saturation 5 minutes white blood cells 6000 blood cells 4800000 no anemia polycythemia platelets normal no parasites The blood (Wassermann reaction) is negative The blood nitrogen 15 mg per 100 cubic centimeters

Urine quantity normal reaction acid specific gravity 1.000 no albumin no sugar white cells red cells casts or bacteria Renal function phenolphthalein test appears normal time 10 minutes 90 per cent in 4 hours

Stomach negative No shadow close to vertebra in the right upper cervical region

Diagnosis Arteriovenous aneurism of the right brachial plexus Complicated paralysis of the eighth cervical and the first dorsal nerves producing motor paralysis sensory vasomotor and sympathetic changes

The sympathetic involvement can be accounted for by injury to the sympathetic communicants of the first dorsal plexus the contracture of the right pupil

The ulnar disturbance is explained by distention of the hand specially on the ulnar side II of the last three fingers is imperforate The little finger is involved only slightly Analysis of the interosus and the last two metacarpals is evident There is a suggestion of the claw hand Sensation of the ulnar surface of the last two fingers is and dorsal surface of the last three fingers is lost

The median nerve shows involvement by reason of the deep pronation of the forearm and the inability to flex the terminal phalanges of the fingers

The shyness bluish condition of the hand the mechanical changes account for the vasomotor alteration The last operation as performed with the indication of first benefiting the process of the right hand through the location of the incision of the right brachial plexus or second what seemed more probable the location of the arteriovenous aneurism and its removal or a possible ligation It was hoped that this would effect a cure by relief of the pressure caused by the aneurism

This latter view is strongly favored by a report

or a very similar case the result of gunshot reported to this society at its March meeting of 1918 by Dr Paul Morf

The operation was performed by the writer June 10 1918 at the Frances Willard Hospital and was prolonged and tedious on account of the great amount of scar tissue—the result of the two previous operations in this locality and because of the pernicious hæmorrhage that accompanied the lightest cut This was due to the extreme dilatation of the internal jugular and all its branches and communications even to the smallest venule

The incision was carried down the right side of the neck from a point about the center of the right cervical region anterior to the sternocleidomastoid muscle to the clavicle and then along the upper surface of the clavicle toward the median line This V shaped trapdoor of skin and subcutaneous tissue was retracted upward and inward and an attempt made to isolate the internal jugular vein and the common carotid artery

The dissection over the upper part of this artery located the bullet that could be readily felt through the unbroken skin It was a soft lead 36 calibre ball The nose had a decided split in it the result probably of hitting a process lower down and then being deflected upward

The internal jugular vein was enlarged to 3 or 4 times its normal size The common carotid was pulseless small and cord like from one end of the wound to the other The thrill was still present and was more marked at the root of the neck

The operation could not be completed nor the source of the trouble reached without enlarging the wound area An additional incision was made across the center of the clavicle and downward for 4 inches below it The clavicle was then resected at the junction of the inner and central thirds and the inner one third of the clavicle was turned inward

The thrill was still palpable as far down behind the first rib as the index finger could reach The communication between the internal jugular vein and the common carotid was in the common carotid artery very low down It was close to the origin of the subclavicular artery or may have been lower down The subclavian pulsations were normal The right common carotid artery was pulseless small and cord like proximal to the communication with the internal jugular vein It was then decided to ligate the internal jugular as low down as possible This was done by two ligatures The subclavian vein was also ligated on account of hæmorrhage The internal jugular was clamped and cut off above the ligatures at the root of the neck and removed as high up as the center of the cervical region The

upper ligation was very difficult on account of the great dilatation of the jugular and the thinness of its walls

In this attempt a severe hæmorrhage occurred It would probably have been safer as regards the immediate result to have tied at intervals the internal jugular instead of resecting it Its resection was undertaken on account of the report on vessel ligation read before this society some years ago by Dr Donald McClain of Detroit He advocated at that time the removal of a section of a vessel rather than to trust to a ligation or multiple ligations for the occlusion of the vessel

After this loss of blood artificial respiration had to be resorted to and the wound was exposed to some contamination

The fifth sixth and seventh nerve roots were exposed in the open wound before the closure and also a portion of the eighth root They were wholly normal in appearance Whether they may have been injured distally from the wound areas is only conjecture

The clavicle was reunited by means of chronic catgut and the wound closed in the usual manner

The patient's recovery was uneventful except for some necrosis of one end of the resected clavicle This readily cleared up resulting in fibrous union and considerable deformity of the clavicle at the point of resection The function of the shoulder is perfect

January 4 1919 examination shows the thrill and pulsation absent

The nerve condition as relates to the hand is unchanged—I can see no improvement and the patient sees none

Two recent similar cases have been brought to my notice The case of Dr Morf and a case reported early in 1918 by Dr Richard Cabot in his case records The case is reported in detail This was possible because he had access to the autopsy records Dr Cabot's case was the result of a gunshot that produced almost identical nerve degenerations with those found in Dr Morf's case and in the present case In the Cabot case an aneurism of the injured vessel was found A consultant staff of six surgeons of the Massachusetts General Hospital advised against an operation six months before The persistence and growth of the aneurism caused them to reverse their former advice

An attempt was made to ligate the internal jugular proximal to the aneurism A severe hæmorrhage occurred The patient died a few hours later from shock The postmortem showed no gross lesion of the roots nor of the plexus other than the degenerative changes caused by pressure



# CORRESPONDENCE

## ACCIDENTS FROM LOCAL ANESTHESIA

I, *U. Ldit*, In 93 I observed death following the injection of cocaine.

A man age 40 had suffered some time with stomach trouble probably due to an epigastric hernia. His general condition was good. The man was not very fat, his lungs, heart and kidneys were normal. On palpation of the liver, no masses were found to be palpable and enlarged. Six centimeters above the umbilicus there was a swelling in the middle line. The swelling could be reduced by pressure but it was painful. An opening of about 1.5 centimeters was felt in the linea alba. I planned to operate on this point on April 5. At 7:30 a.m. I injected on of 10 milligrams of morphine as given in the forearm. At 8:30 the man was placed on a horizontal table. The skin was disinfected with iodine. An injection of 1/1000 per cent novocaine with 100,000 adrenalin was given. When my assistant put the needle the patient seemed to be unconscious. His face and limbs turned pale and the pulse was small and weak before more than 1 or 2 cubic centimeters were injected. My assistant, who is an expert in administering local anesthetics, then told a moment after a few minutes he continued the injection and the man grew miserable again. At this moment quantity of not more than a half cubic centimeter was injected. My assistant again stated and the patient seemed to recover but not for long. He soon became miserable again and suddenly rolled off the table and fell on the floor, hurting his nose. He was very cyanotic and breathed convulsively. The pulse was very small and weak. In spite of injections of oil camphoratum, massage of the heart and artificial respiration, my special apparatus the patient died in a few minutes.

*Postmortem:* The patient is of normal stature. There is a swelling in the linea alba 4 fingers above the umbilicus, around which are eight stab wounds from the needle extending in a circle from the umbilicus. If any to the typhoid process of the sternum. The swelling consists of preperitoneal fat and slips through an opening in the fascia. Situs viscerum normal. The omentum is free throughout the intestines. The peritoneum looks bright. No adhesions present. The diaphragm on the right side is at the fourth rib and on the left at the fifth. The left lung collapses and is totally free. The right lung has many soft adhesions to the costal pleura and collapses not so well as the left lung. No hydrothorax is present. In the pericardium there is slight hydropericardium. The left ventricle three fingers, the left four. The femoral oval is open. The

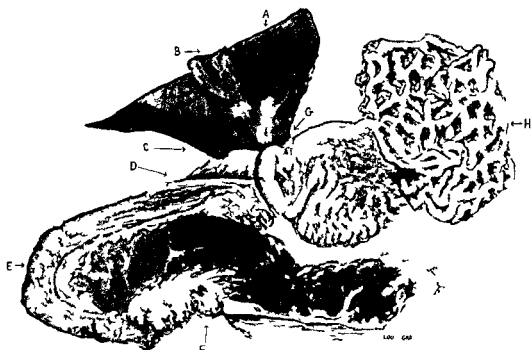
abdominal centimeters in diameter. The heart is soft. The valves are normal. Both lungs are very plethoric. There is no edema or signs of tuberculosis or inflammation. The stomach is large, the appendix normal. The kidneys are very lobed but the surface is normal (450 gr). The spleen is large (30 g). The liver is large, the testicles normal. The testicles are small and in the scrotum. The thyroid is not enlarged. The thymus persists. No swollen glands. Number of papillae circumvallatae normal.

The cause of death is not easy to explain. Was it due to nervous shock or to an acute intoxication? There is a slight indication of so-called staphylinic lymphaticism, the kidneys being lobed and the foamen of the lymphatics. The effect may suppose that these conditions prevent the narcotic would have a greater effect than in normal cases. However, the nervous shock caused by the prick of the needle had already passed and the injection was completed before the real collapse occurred. If death was due to an intoxication, the time between the injections and death was very short and the dose of novocaine small.

In more than 6,000 cases I have injected the same or larger doses and I have observed no cases of a serious nature—such as a gynecological operation, where it is necessary to anesthetize the pelvic region—a kind of shock one to two hours after the operation and sometimes even when small doses were used there as reaction during the operation. In such cases the patient turns pale and the blood pressure is diminished. I take it that these symptoms are the effect on the circulatory system of the combination of the injection and the reaction from the operation. Such phenomena often appear just at the moment when the surgeon pulls the intestines out of the abdomen or hugs the prostate in doing a herniotomy. I sometimes have seen the center of the appendix is squeezed together. In all of these cases a reflex is to be expected, the nerves not being blocked at all.

Even in making skin incisions and in cutting the subcutaneous tissue when there is no perception of pain at all I have sometimes observed the same reaction. In the case reported the hole pierced took place some time before the operation. It is possible that some novocaine was immediately injected into the vein. This is not probable, however. The vein near the linea alba are not very large and the technique used by my assistant prevents such an accident as he moves the needle during the injection. The H. D. J. S. M. K.





# SURGERY, GYNECOLOGY AND OBSTETRICS

AN INTERNATIONAL MAGAZINE PUBLISHED MONTHLY

VOLUME XXVIII

JUNI 1919

NUMBER 6

## THE EXPERIMENTAL PRODUCTION OF PANCREATITIS IN ANIMALS AS THE RESULT OF THE RESISTANCE OF THE COMMON DUCT SPHINCTER

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LISTED BY MR BROW MEDICINE 1920

A REVIEW of the literature concerning the etiology of pancreatitis which has appeared in the last twenty years reveals the somewhat remarkable fact that observers have apparently been content to remain satisfied with the general idea (well founded so far as it goes) that the cause of pancreatitis in some way is closely connected with gall stones and inflammations of the biliary tract. That this conception of the etiology of the disease fails to account for a large proportion of the cases has I am sure been noticed by those who have had any experience in the matter and have striven to think about it. On the other hand I am confident it will be generally admitted that this still largely unsolved problem concerning the immediate cause of pancreatitis and its *modus operandi* is of great importance and thus because lacking this key the door to rational treatment can hardly be opened or at any rate opened wide.

In what follows I desire first to review as briefly as may be the work hitherto accomplished along this line second to set down an account of certain experiments and observations which seem to afford a reasonable explanation of the immediate cause of pancreatitis whether acute or chronic and finally to suggest as a corollary the rational treatment.

The history of our knowledge of the etiology of pancreatitis has been summarized in a number of articles during the past few years and particularly well by Opie (1) by Opie and Meakins (2) and by Guleke (3) so that it is hardly necessary to repeat it here in any detail. If one were to attempt a resume of our knowledge in this field it might not unfairly be stated somewhat as follows. The essential *pathological* lesion is necrosis of the pancreatic cells or masses of cells. This is *primary* (Opie and Meakins). Hemorrhagic inflammation infection are all secondary. What has for long been called acute hemorrhagic pancreatitis ought to be called acute hemorrhagic necrosis of the pancreas (Opie and Meakins) or better still simply acute pancreatic necrosis (Guleke). Hemorrhagic gangrene and supputation are merely complications and frequently do not appear at all. A limited necrosis remaining aseptic may be replaced by fibrosis. Extensive mass necrosis results in pancreatic sloughs or sequestra. Chance infection of the necrotic area may result in pancreatic abscess but is infrequent.

As to the *mode of causation* a large number of experiments has shown that a variety of irritating substances—practically all of which have been injected into the pancreatic duct or the parenchyma by means of syringe and

needle are capable of causing in animal the same lesions that are observed in human cases that come to autopsy. The first of these substances was a mixture of bile and sweet oil which Claude Bernard in 1866 injected into the pancreatic duct of the dog causing death in 18 hours from acute hemorrhagic pancreatitis. A partial list of other substances include gastric juice (Hlava 4 1890) duodenal contents (Polya 5 1906) weak solution of a number of acids such as hydrochloric nitric and chromic acid as well as of alkalis (Flexner 6 1900) formalin sweet oil fatty acid and sodium soaps of the fatty acid and finally bile (Opie 7 1901) the bile salt in pure solution (Flexner 8 1906). On the other hand certain substance which from their bland nature one might anticipate would be unlikely to cause trouble have been found to do little or no harm such are blood serum agar agar gelatine paraffin starch emulsion and also cultures of certain bacteria when not too virulent or in too great quantity.

Now it is obvious that of all these substances the most natural one to think of as a possible cause of the disease in the human is bile and as regard this substance we owe the bulk of our knowledge to Opie and to Flexner. In 1901 Opie (7) demonstrated that injection of bile into the pancreatic duct of an animal would cause necrosis of the organ and at the same time he proved by a now celebrated autopsy observation (from Professor Halsted's clinic) that a small gall stone lodged at the duodenal orifice of the bile papilla might divert bile from the common duct into the pancreatic duct and in this way set up a fatal hemorrhagic pancreatitis. A few similar observations have since been recorded (Bunting 9 1906 Crowell). In 1906 the solution of the problem was materially advanced by Flexner (8) who demonstrated that the essential constituent of the bile responsible for the necrosing effect in the pancreas lay in the bile salts of which the taurocholate was much more active than the glycocholate. He also showed that the colloid that is the mucin and nucleoproteins of the bile were not only innocuous but even protective. The mucin he affirmed modified

the action of the bile salts the effect being shown in a less fatal character of the experiment and a less acute and destructive inflammation. That this was due to the colloid nature of the mucin and not to any directly antagonistic substance contained in it he proved by using such other colloids as agar gelatine and gum arabic which being mixed with solution of the bile salts secured the pancreas against necrosis in the same way as when the bile contained the proper proportion of mucin and nucleoprotein. He went on to point out that in the human the composition of bile when imprisoned in the gall bladder changes in favor of the mucin constituent and in the direction of a loss of diffusible salt is the result of inflammatory processes and he thought that such bile would theoretically be apt to cause subacute or chronic lesion rather than acute ones. Whether Flexner was correct in either of the assumptions has not yet been demonstrated and indeed there is something to be said against them.

The experimental work of Nordmann (13) came nearest to imitating the conditions of nature. He closed the papilla by purse string suture and then forced bile or infectious material into the common duct and so into the pancreatic duct. After purse string suture alone without injection of anything into the common duct there developed only jaundice dilatation of bile and pancreatic ducts and occasionally a few small fat necroses. He also found that bile often entered the pancreatic duct without doing any particular harm. He then added bacteria in the shape of a broth culture 24 hours old obtained from the feces of a dog. Of this he injected one half a cubic centimeter into the gall bladder. All such animals died in 48 to 65 hours with vomiting. In fourteen cases there was typical pancreatitis with bloody serous exudate numerous fat necroses and greatly swollen pancreas colored dark gray to black with small and large hemorrhages. He believed that the necrosing effect on the gland tissue was caused by stagnating infected pancreatic juice sometimes mixed with bile and that probably the disturbance was of a chemical nature. He thought the necrosing action

attacked chiefly the interstitial tissue but sometimes also the gland lobuli

The theory that duodenal contents might be forced back through the papilla and thence into the pancreatic duct had been maintained in particular by Hess (10) and by Williams and Busch (11) who demonstrated a sort of paralytic dilatation of the mouth of the common duct immediately after a fair sized gall stone had passed through into the duodenum. They assumed that through this temporarily opened door the duodenal contents might be dimmed back by irregular peristalsis into the common duct and the pancreatic duct. This theory still remains theory. In any case under normal circumstances it has been found impossible by experiment such as the complete obstruction of the duodenum below the papilla to force back the duodenal contents into the common duct (12). Early experiments of the writer using an iron solution introduced into a small loop of the duodenum closed by ligatures from just above to just below the bile opening under a pressure of 1000 millimeters of water maintained for an hour demonstrated that none of the solution would enter the bile or the pancreatic ducts.

From the clinical side there soon came apparent support of Opie's hypothesis of the retrojection of bile into the pancreas through gall stone obstruction at the papilla. Statistics concerning the coincidence of pancreatitis with gall stone disease and the location of stones in the various parts of the biliary tract in cases of pancreatitis were published by Opie, Halsted, Koerte, Fieber, Mayo, Robson, Igdahl and others. Thus Igdahl (14) for instance in a series of 105 cases of pancreatitis found gall stones present in 44 but only in three was a stone in or near the ampulla. Robson says that the pancreas is involved in 60 per cent of gall stone cases. Quenu and Duval (15) put it at 50 per cent.

Finally there should be mentioned the theory of Menger (16) supported in Germany by Arnsperger (17) and in this country strongly by Deaver (18) to the effect that the cause of pancreatitis is in many cases to be sought in a spread of infection from the gall bladder wall through lymphatics to the

cystic lymph node thence by a periductal lymphangitis through the nodes along the common duct to those at the head and margin of the pancreas and thence to the regional lymphatic distribution in the head of this organ. Deaver points out that out of 79 patients with chronic pancreatitis 72 or 91 per cent showed evidence of infection in the bile passages 47 or 53 per cent had gall stones and 30 or 38 per cent had none.

The arguments of a high authority such as Professor Deaver demand close examination and can not lightly be set aside. Yet to the writer this conception is difficult of acceptance. It is probably true that cancer cells stray in the breast when their natural course to the axilla is blocked may be transported or as is more likely may grow in lines by contiguity backward against the lymph stream and so produce metastases apparently anomalous in the other side of the chest wall or in the epigastric lymph routes. But does this occur in infections? Possibly it does again by contiguous growth. But does it occur when there is a barrier of lymph nodes to pass? The swollen glands lying above the pancreas are surely more reasonably to be regarded as the result of a primary pancreatic inflammation than as the sign of an infection coming from the gall bladder and breaking through their guard to reach the pancreas. In cats in which I have caused a pancreatitis these glands are found acutely swollen obviously as the result of the pancreatic lesion. The demonstration of the possibility of injecting the lymphatics of the head of the pancreas from those of the gall bladder or cystic duct is but small proof of the assumed fact that infectious material actually does take such a route. The lymph nodes draining any organ serve as a barrier to retrograde infection coming to that organ from elsewhere. It is most unlikely that the pancreas should be invaded by the lymph route. Not only is this the case but a further argument is found in the fact that rarely is the pancreas the seat of a bacterial inflammation. Cultures from all but the frank abscesses which are rare are usually sterile and sterile also from some of the abscesses. An infection

coming by way of the lymphatics would usually to judge from analogous experience be bacterial in origin and in type and pancreatitis would much more often than in the case be suppurative.

For the sake of completeness it should be mentioned that there exists a small amount of experimental evidence and of clinical evidence also to show that an inflammation of the pancreas can be hematogenous in origin. There are for instance a few cases on record in which suppurative pancreatitis has been observed as a complication of general infections. Then again in such a disease as mumps or measles (Edgcombe or Sumner) have seen symptoms of acute pancreatitis in a few instances. Similarly in typhoid influenza and in one case of mastitis (Dreesmann) has pancreatitis been found. Such clinical evidence is far from convincing as proof of the hematogenous origin of the disease. Now that we know how frequently the bile becomes infected presumably through the liver in generalized infections it is quite as legitimate to suppose that the pancreatitis resulted by way of the bile tract is by the blood. Kosenow's recent work indicating that bacteria can invade the wall of the gall bladder by way of the blood and that this localization is very often selective is extremely suggestive but even admitting this it is obvious that the causative factor in pancreatitis is not thereby explained. The infection of the gall bladder can at most be regarded only as a first step and not even a necessary step in the production of pancreatitis.

As a net practical result of all this work it is probably not unfair to say that clinicians generally have combined rather loosely the experimental with the clinical and autopsy evidence into the general conclusion that pancreatitis is caused by the retrojection of bile into the pancreatic duct as the result of obstruction by a gall stone at the outlet of the common duct and that when this mechanism is inadmissible by reason of the absence of stones the pancreatitis is in some way due to infection of the biliary tract either by a plug of shreddy mucus blocking the papilla just as a stone might

block it or by a direct spread of infection along lymphatics from the infected gall bladder wall into the substance of the head of the pancreas—(Deaver 18).

Now the fact above mentioned (concerning the large proportion of cases of pancreatic swelling in which stones and even infection are absent) has been becoming increasingly obvious to clinicians and especially to surgeons accustomed to routine palpation of the pancreas in upper abdomen operation. In any case the writer's attention was forcibly attracted to it by an analysis of some 34 cases of pancreatitis (19) which revealed the fact that in over 50 per cent operation demonstrated the absence of either gall stones or cholecystitis. The conclusion imposed itself that there must exist some cause of the pancreatic swelling other than those indicated in the foregoing resume. It seemed obvious that bile which in experiments reproduced so accurately the pathological lesion of pancreatitis as observed in the human must be the one altogether likely cause. The problem therefore was how to explain its entrance into the pancreas in the absence of any mechanical obstruction such as a gall stone or a plug of mucus at the outlet of the common duct. Clearly the obstruction would have to be an anatomical or a physiological one. The problem being thus fitted it seemed only natural to postulate the existence of a sphincter at the outlet of the common duct. At this point the writer was unaware that the existence of such a sphincter had long ago been demonstrated. There was nothing in surgical literature at the time (1911) to indicate that surgeons generally knew of such a thing. As a matter of fact the observation had been made by a physiologist and had remained like many other physiological observations of which the bearing on clinical medicine is obvious once they become widely known more or less hidden in physiological textbooks. A little reflection was sufficient to convince one that there must be a sphincter at that point. For one thing there was the well known fact that the discharge of bile into the duodenum is intermittent while the secretion of bile is continuous. There was



Fig. Cat 86. Lower microphotograph. Many of the acinar spaces seen in the lobules contain in the stained specimen yellow amorphous substance which represents very possibly the bile forced into the finer ducts of the pancreas. In other spaces there are capillaries shown in pinkish red presumably representing blood although blood elements are indistinguishable in the general necrosis. Some of the spaces seem to represent total necrotic cells or groups of cells of which only the cell outline remains as shadows. The lack of all definition seen in the photograph represents total necrosis.



Fig. 2. Cat 90. Lower microphotograph. In this specimen the definition is a shade better than in Cat 86 but the necrosis is still seen to be quite marked. Nuclei can be seen but the protoplasm of the cells of whole lobules is so necrotic that it looks as if it has been melted. Cell outlines can no longer be made out. The cells have run to ether and the tissue looks muddy.

also the fact that the bile ducts dilate after the gall bladder is removed a result which could only be attributed to some normal obstructing action at the end of the common duct. Acting on this assumption an experiment was performed on a dog which demonstrated in a few moments the existence of such a sphincter. With a cannula in the gall bladder attached to a funnel holding a methylene blue solution and with the duodenum open exposing the bile papilla the fluid was observed to run through into the duodenum intermittently at any pressure which was not a paralyzing one and indeed the muscular contraction of the sphincter when it braced itself from time to time against the pressure of the fluid behind could be perfectly well seen with the naked eye.

Some time later a search of the literature revealed the fact that this sphincter had been discovered and thoroughly described by the Italian physiologist Oddi (1 and 2) who published two or three papers on the subject in the years 1887 and 1888. Appear-

ing as it did in an Italian journal and not in one of the better known Oddi's very important observations escaped general notice. A reference to it is found in the larger textbooks of physiology but clinicians both in Europe and America apparently knew nothing of it or if they did failed to see that it had any bearing on clinical problems. It may therefore be of some interest to review briefly his work.

Oddi studied this muscle both physiologically and anatomically. In brief he found that the sphincter in dogs was able to resist a pressure of 50 millimeters mercury which equals about 675 millimeters of water. He demonstrated in microscopical sections that the sphincter was composed of a special bundle of circular fibers. He found that the common duct outside its course through the bowel wall possesses no muscular fibers. From the physiological side he discovered that this sphincter could be put into spasm by a mechanical irritation of the duodenal mucosa or by the application of dilute hydrochloric acid in either the duodenum or the stomach and that even mere cutting of the bowel to expose the papilla would cause spasms lasting from twenty to thirty seconds. Stimulation of the vagus apparently provoked a very prompt and intense contraction of the sphincter. A like result was obtained



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block it or by a direct spread of infection along lymphatics from the infected gall bladder wall into the substance of the head of the pancreas—(Deaver 18).

Now the fact above mentioned (concerning the large proportion of cases of pancreatic swelling in which stones and even infection are absent) has been becoming increasingly obvious to clinicians and especially to surgeons accustomed to routine palpation of the pancreas in upper abdomen operations. In any case the writer's attention was forcibly attracted to it by an analysis of some 34 cases of pancreatitis (19) which revealed the fact that in over 50 per cent operation demonstrated the absence of either gall stones or cholecystitis. The conclusion imposed itself that there must exist some cause of the pancreatic swelling other than those indicated in the foregoing resume. It seemed obvious that bile which in experiments reproduced so accurately the pathological lesions of pancreatitis as observed in the human must be the one altogether likely cause. The problem therefore was how to explain its entrance into the pancreas in the absence of any mechanical obstruction such as a gall stone or a plug of mucus at the outlet of the common duct. Clearly the obstruction would have to be an anatomical or a physiological one. The problem being thus stated it seemed only natural to postulate the existence of a sphincter at the outlet of the common duct. At this point the writer was unaware that the existence of such a sphincter had long ago been demonstrated. There was nothing in surgical literature at the time (1911) to indicate that surgeons generally knew of such a thing. As a matter of fact the observation had been made by a physiologist and had remained like many other physiological observations of which the bearing on clinical medicine is obvious once they become widely known more or less hidden in physiological textbooks. A little reflection was sufficient to convince one that there must be a sphincter at that point. For one thing there was the well known fact that the discharge of bile into the duodenum is intermittent while the secretion of bile is continuous. There was



Fig. 1. Cat 86. Low power microphotograph. Many of the acinar spaces seen inside the lobule contain in the stained specimen yellow amorphous substance which represents very possibly the bile forced into the finer ducts of the pancreas. In other spaces there are capillaries showing pinkish red presumably representing blood although blood elements are indistinguishable in the general necrosis. Some of the spaces seem to represent total necrotic cells or groups of cells of which only the cell outline remains as shadows. The lack of all definition seen in the photograph represents total necrosis.



Fig. 2. Cat 90. Low power microphotograph. In this specimen the definition is a shade better than in Cat 86 but the necrosis is still seen to be quite marked. Nuclei can be seen but the protoplasm of the cells of whole lobules is so necrotic that it looks as if it has been melted. Cell outlines can no longer be made out. The cells have run together and the tissue looks smudgy.

also the fact that the bile ducts dilate after the gall bladder is removed a result which could only be attributed to some normal obstructing action at the end of the common duct. Acting on this assumption an experiment was performed on a dog which demonstrated in a few moments the existence of such a sphincter. With a cannula in the gall bladder attached to a funnel holding a methylene blue solution and with the duodenum open exposing the bile papilla the fluid was observed to run through into the duodenum intermittently at any pressure which was not a paralyzing one and indeed the muscular contraction of the sphincter when it braced itself from time to time against the pressure of the fluid behind could be perfectly well seen with the naked eye.

Some time later a search of the literature revealed the fact that this sphincter had been discovered and thoroughly described by the Italian physiologist Oddi (1) and (2) who published two or three papers on the subject in the years 1887 and 1888. Appear-

ing as it did in an Italian journal and not in one of the better known Oddi's very important observations escaped general notice. A reference to it is found in the larger textbooks of physiology but clinicians both in Europe and America apparently knew nothing of it or if they did failed to see that it had any bearing on clinical problems. It may therefore be of some interest to review briefly his work.

Oddi studied this muscle both physiologically and anatomically. In brief he found that the sphincter in dogs was able to resist a pressure of 50 millimeters mercury which equals about 675 millimeters of water. He demonstrated in microscopical sections that the sphincter was composed of a special bundle of circular fibers. He found that the common duct outside its course through the bowel wall possesses no muscular fibers. From the physiological side he discovered that this sphincter could be put into spasm by a mechanical irritation of the duodenal mucosa or by the application of dilute hydrochloric acid in either the duodenum or the stomach and that even mere cutting of the bowel to expose the papilla would cause spasms lasting from twenty to thirty seconds. Stimulation of the vagus apparently provoked a very prompt and intense contraction of the sphincter. A like result was obtained

by stimulating the central end of the cut splanchnic while stimulation of the splanchnics had no effect. He also observed dilatation of all the extrahepatic ducts in dogs deprived of their gall bladder. He thought a catarrhal condition in the duodenum was a stimulus to the sphincter and that this might explain some case of icterus where other causes could not be found.

It may be said that at the time that the writer's experiments were begun there was no opportunity of becoming acquainted with the original article of Olden so that a considerable number of the earlier experiment were undertaken independently and in the result merely served to confirm his work. They were first begun in the fall of 1911, were continued intermittently during 1912 and 1913, and have been resumed during the past year. In a paper published in the *Canadian Medical Association Journal* July 1913 (3) the early results were recorded very briefly. They amounted to this: that the hydrostatic pressure in the common duct that is the pressure which the sphincter at the papilla of Vater will oppose to a column of water was surprisingly high. The sphincter was rarely completely overcome by any pressure less than 600 millimeters. In this paper the hypothesis was first suggested that small quantities of bile might be forced back into the pancreatic duct by the resistance of the sphincter and therefore cause or help to maintain the condition of pancreatitis. In April 1913 (4) further experiments were recorded in the *Canadian Journal of Medicine and Surgery* and the suggestion was made that in the operation for pancreatitis instead of doing a cholecystectomy or cholecystenterostomy it would be more rational to abolish the sphincter action at the papilla of Vater. It was demonstrated in dog that the operation reduced hydrostatic pressure in the common duct from a level of 500 to 600 millimeters of water before the procedure down to 70 millimeters or less after it and that this reduction was permanent for as long as eight weeks at least after operation. In this way the possibility of the sphincter damming bile back into the pancreatic duct would be permanently obviated.

In this article it was also shown that the operation of cholecystenterostomy which had been advised by some as a form of bile drainage or rather as a means of diverting the flow of bile from the common duct in the idea of preventing the passage of infected bile past the open mouth of the pancreatic duct was based on faulty physiology. A cholecystenterostomy as was shown by experiments would fail to divert more than a very minute quantity of bile so long as the common duct was not blocked and inasmuch as in the great majority of cases of pancreatitis the obstruction to the common duct is slight and transitory the operation of cholecystenterostomy is ordinarily contraindicated. This by the way.

In an article published in the *Canadian Medical Association Journal* for February 1913 (19) upon the diagnosis and treatment of subacute and chronic pancreatitis it was mentioned that the keynote of the treatment of pancreatitis consisted in the insertion of a safety valve in the biliary system in order to obviate any excessive rise of pressure in that system thus giving the pancreatitis a chance to subside naturally and that in case of considerable swelling and hardness of the gland such a safety valve preferably a cholecystomy ought to be maintained for a much longer period than was generally done. Three months might be considered a not too long though in milder case a shorter period might suffice.

The experiments of the year 1913 were directed toward the demonstration of the possibility of driving a solution introduced by way of the gall bladder into the pancreas through the relaxing action of the sphincter. It was found possible in cats to flood the pancreas with a solution containing iron introduced into the gall bladder at a water pressure of anything from 300 up to 800 millimeters the iron being found in the pancreas at autopsy by appropriate staining reaction. The results were embodied in a paper read at the 17th International Congress of Medicine in London August 1913 (23). The bearing of this work upon the problem was of course both clear and close.

After a prolonged absence abroad the

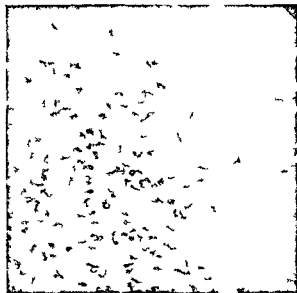


Fig 3 Cat 94 High power microphotograph. Note the secondary degree of necrosis and the formation of aculei in which the thin left but the nucleus the protoplasm has disappeared. In the denser parts the protoplasm in the stained specimen shows absolute granular necrosis and looks as if melted. Cell outlines are broken down and have largely disappeared.



Fig 4 Cat 96 High power microphotograph. The same necrosis is seen in most of the specimen. At the edge is tissue partly preserved.

problem was again taken up in the Laboratory of Experimental Medicine of McGill University in January 1918 and the present paper records this last group of experiments.

It seemed natural to proceed from the point at which previous work had stopped. The problem now was to induce pancreatitis with bile by forcing this bile into the pancreas in the same manner as had been done with the iron solution. It may be said that almost as soon as the experiment was successful and we were able to produce an acute hemorrhagic pancreatitis with death in half an hour. This was in cat No 86. Certain outstanding experiments will be set down in detail while the others can be abbreviated. At this point it may be well to indicate that the experiments as a whole may be grouped in three classes according to the nature of the bile used.

I Ox bile infected with various organisms.

II Human bile from a cholecystostomy case passed through a Berkfeld filter and autoclaved.

III Solutions of bile salts.

### III Solutions of bile salts

Group I Those in which infected ox bile was used.

Cat No 86 April 3 1918. With a cannula tied into the gall bladder and attached to a funnel with rubber tubing there was allowed to run in ox bile which had been inoculated with staphylococcus flavus and incubated for forty eight hours. Pressure was immediately raised to 300 millimeters. (The normal pressure of bile as secreted in the liver is not over 100 to 150 millimeters.) It was kept at 300 for 45 seconds after which bile obviously began to run through into the duodenum as shown by the decreasing level in the funnel. The pressure was then lowered to 100 then raised to 300 for 20 seconds then to 400 for 20 seconds at this point the gall bladder was found to become distended. It was then raised to 300 for 30 seconds and bile was now observed to run through freely into the duodenum. It was then lowered to 100 and the sphincter thus given a rest for one minute. It was then raised to 200 for 2 minutes during which time there was no flow into the intestine. Then to 250 and now the flow began into the intestine but slowly and in small quantities. It was then lowered to 100 for 30 seconds then raised to 300 again when the flow began again in small quantities. It was then lowered to 100 for 30 seconds and raised to 300 for 3 minutes. At this level there was practically no flow. Particles in the glass cannula could be seen sometimes going into the gall bladder at others being forced back obviously there was intermittent sphincter action. Pressure was now lowered to 100 for 4 seconds then raised to 350 for 45 seconds and then without further lowering raised suddenly to 600. At this point the sphincter obviously gave

very quickly and the contents as a free rapid flow into the duodenum. After 30 seconds it was lowered to 100 and the operation terminated. The whole procedure lasted about 1 minute and 80 cubic centimeters of bile were used. It was noted soon after that the cat had stopped breathing though the heart was still beating. Measures of resuscitation failed. Immediate postmortem showed complete hæmorrhagic pancreatitis from end to end (see front piece). The stomach as far as to contain about 10 cubic centimeters of the bile used but it was not congested or abnormal. The duodenum a practically empty the common duct was dilated and the contents in the gall bladder not to be found. A culture was taken from the pancreas with precautions and a pure growth of the staphylococcus was secured.

The histological appearances were as follows. The pancreatic tissue had undergone a hyaline necrosis over large extent. While lobules are necrotic in other places only part of a lobule the fairly healthy appearing or gradually into the hyaline mass. Apparently the necrosis has extended from the center of lobule outward as the periphery is the best preserved. In many of these areas the capillaries actually no hæmorrhage in others the capillaries are blocked the blood even into the finest ramifications of vessels separating the individual tubules but the capsule of the bile duct to the tubes proper is in only a few places and the rest is not tensed. There are areas of half a centimeter diameter by loss of staining of the cytoplasm and nuclei. The necrosis extends though probably three fourths of the gall bladder and the obvious that a great part would ultimately have been lost if a longer. The individual lobules are enormously separated by cleavage spaces which represent probably an intense cedema. It could seem as if necrosis were the primary lesion and hæmorrhage proceeded by the action of the cedema.

The same section stained by Grams and the remaining half of the staphylococci are to be seen. In the area of solid necrosis they are almost entirely absent except for occasional capsular vesicles in which can be seen a plug of lymphoid cells and cocci. In the congested capillaries cocci are conspicuous by the absence of the small plug of connective tissue and the contact between the cells in lobules and the arteries not blood vessels. Search was made for branches of the pancreatic duct and in one a lump of erythrocytes was found containing numerous staphylococci indicating that the entire course of the ducted bile was by way of the pancreatic duct. The same was found in a very minute branch of the pancreatic duct lying in the center of a lobule. A capillary containing blood running just below it contained no bacteria. Many of the cells lining the small duct were necrotic.

In the hamatoxylin section it is seen that the branches of the pancreatic duct are lined with necrotic cells with great loss of nuclear staining and breakdown of cytoplasm. Even the fibrous

tissue of the wall of such ducts stains badly and is obviously necrotic. At the splenic end the section shows in general the same change as those just described but if possible even more extensive. Actually the whole tissue has undergone hæmorrhagic necrosis and the fibrous stroma also is necrotic to a lesser extent.

Here then we have a clear instance of sudden death within 20 minutes of the close of the operation from a fulminating pancreatitis caused by the forcing of infected bile into the pancreatic duct through the resistance of the common duct sphincter without there being any other factor whatever in the causation of the lesion. The proof seems complete as regards the role which the sphincter of the common duct may take in the causation of pancreatitis.

In another cat we were fortunate enough to reproduce the condition of subacute pancreatitis with death in sixteen days. The experiment was as follows.

Cat No 84 March 30 1908 Cannula in the gall bladder. Oxidized catgut sutured the staphylococcus aureum on March 2 incubated for two days and the third day kept at room temperature. The duodenum was opened for observation. The bile was uninflamed of 500 quickly raised to 100. It appeared immediately in the duodenum. Pressure on the ureter to 100 and flow stopped. Then raised by 50 up to 250 when little bile came through at the papilla at intervals then raised to 450 at which a quiet small flow became continuous. Lowered to 100 flow resumed quickly to and there was an immediate flow of bile through the papilla. Lowered to 100 flow ceased and resumed quickly to 400 which gave a slight flow continuing slowly with the sphincter was obviously holding pressure was then kept at 400 the sphincter still holding for 15 minutes. This ended the experiment the duodenum and the gall bladder were closed and the abdominal wound sutured. About 2 cubic centimeters of bile were used and the experiment lasted about 1 minute. It was considered that the sphincter resisted all at 400 but gave way at 450. At the end of the experiment it was observed that all the pancreas in the neighborhood of the duodenal opening was of the length of 1 1/2 inches as darkened and contracting strongly with the normal pink color to and the pleural cavity the duodenum. The cat recovered well and seemed normal for some days. Toward the middle of the second week it refused food but as not apparently suffering pain. On the morning of April 16 it as if dead but still alive. Postmortem was done 18 hours after the death. The esophagus and diaphragm were sclerotic and the membranes were highly

had probably to judge from its depth been present for several days although the orderly had not noticed it. On opening the abdomen the whole abdominal cavity in front of the omentum and over the anterior surface of the liver was found to be covered with a layer of yellow mush which could be scraped off very easily but which on the liver left in places a ravish surface indicating a several days old inflammation. There was a small amount of thick yellow fluid in each flank. In the omentum there were a few spots of fat necrosis while in the mesentery behind the pancreas and especially close to the duodenum these were quite numerous. The pancreas was diffusely thickened nodular and hard being enlarged to about twice its normal size. The thickening was diffuse throughout the organ but especially marked in the portion adjoining the entrance of the pancreatic duct into the duodenum. The pancreatic tissue looked pale but also dull and opaque. There was no obvious obstruction in the common duct but it is probable that the jaundice was due to obstruction at the site of the sphincter either from pancreatic swelling or from spasm of the sphincter inasmuch as the yellow mush found free in the abdomen was also found in the common duct and a considerable quantity of it in the gall bladder while the duodenum was absolutely empty as also the rest of the small bowel. The escape of this yellow inspissated bile can only have occurred through the fundus of the gall bladder where a ligature had been applied to close the cannula opening. But this was not clearly demonstrated as the gall bladder was cut open carelessly before this point was determined. The black silk ligature could not be found but the bile tract from the gall bladder out to the dome of the liver was continuous and the dome of the liver also showed the oldest lesions. The liver was yellow pale and fatty and one small abscess was found upon cutting it open. Death was probably due rather to this infective hepatitis and to the peritonitis caused by the exit of infected bile than to the pancreatitis. A smear from the peritoneal exudate stained with methylene blue revealed no pus cells but only amorphous debris with many minute needle crystals.

Microscopic sections showed the following: (1) At the duodenal end there is marked oedema with great separation of acini. In parts the tissue seemed well preserved but over a large portion of it the cells and the acini are much degenerated and loosened from their basement membrane they have lost their nuclei and lie scattered and independent. The structure of the gland is broken up with loss of the acinar arrangement. There are no foci of necrosis in mass. Inflammatory signs are lacking. A section stained by Gram's does not show bacteria. (2) Section opposite the pylorus resembles in general that of the duodenal end just described but there is also a patchy infiltration with small round cells and considerable thickening around blood vessels indicating a subacute inflammation which has subsided. It is a picture of early

cirrhosis in patches. (3) At the splenic end there is oedema increase of the fibrous tissue in the septa and considerable cell necrosis. The architecture of the gland is partly disorganized.

A section of the swollen gland lying above the pancreas shows an acute catarrh with much exudate and a large proliferation of endothelioid cells together with some fatty degeneration of cells. The liver shows multiple small recent abscesses. A section of the omentum shows massive necrosis together with signs of inflammation much more marked than in the pancreas.

Cat No 80 March 16 1918. Injection with syringe directly into the gall bladder of about 10 cubic centimeters of a solution of inspissated or gall (commercial sample) inoculated with *Bacillus coli communis* and incubated for 48 hours. Specific gravity 1.08. Duodenum opened. Fluid injected several times with short sharp rises in pressure. Application of 5 per cent hydrochloric acid on duodenal mucosa. Sphincter was seen to hold for several seconds then gave way.

March 17th found dead but warm at 11 a.m. without rigor. Immediate postmortem probably three to four hours after death. Peritoneum clean and dry. Pancreas adjacent to papilla congested and firmer than rest of organ otherwise nothing of special interest except for a large acutely swollen lymph gland at the upper border of the pancreas. Microscopic sections show: (1) at *splenic end* of pancreas numerous hyaline necrotic areas densely packed. Parenchyma between these areas is oedematous and shows beginning necrosis with loss of cell outline. (2) At the *duodenal end* diffuse oedema swelling throughout marked swelling of cells with many cell necroses but no mass necrosis except that a whole alveolus may be necrotic. Vessels filled with coagulated amorphous stuff. (3) At *one inch below pylorus* little change merely a slight cloudiness in some areas. (4) Liver shows numerous focal necroses. Cultures taken from the interior of pieces of the pancreas after thorough cauterization of the surface gave positive growths of gram negative and gram positive bacilli with staphylococci. These were found in all parts of the organ and bacteria could be seen in the stained sections.

Cat No 81 March 6 1918. The same bile as used in Cat No 80 standing for past four days at room temperature introduced through funnel with cannula in the gall bladder. Bile run in at a measured pressure varying from 200 to 800 millimeters pressure being kept up for 10 to 30 seconds with intervals of one to five minutes to allow sphincter to recover.

Cat died 13.4 hours after commencement of experiment. Immediate postmortem. Pancreas dull greyish with faint shade of pink and on cross section showed slight congestion of capillaries. Toward the tail nearly normal in color not enlarged. Stomach much congested and filled with bile. Bile in the small intestine down to within a foot of the

Lu gs ppe lobes clea ight lo r very  
much on et d left lo er slightly so Blood  
st d flu d m de ate amount in the peritoneum  
Cultures from the peritoneal flu d nd f m three  
dlt nt e n the pin eas remained sterile  
On lo j culture fr m th pa ea ne pylo us  
h h th f ag am positive o cus There  
a a much en rged a d lle lymph gland  
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Cat N s April 3 o b Can ulain gall bl d le  
duodenum n t ope ed Bile emptied from gall  
bladder A ltle sal ne run throu h at press c f  
oo millim tes Th p s ed into luode um I

su e lowe ed to 100 millimeters O bile lkal e  
to l t mus i oc lated th bacillus subtilis 8 hours  
pre ously run int gall bladder at pressu e of 600  
mill m ters d ring 30 seconds I owered to oo

millimeters fo 1/ minutes Raised to 400 f r  
t o minutes Lo ered to 100 Raised to 500 for  
half a minute Lo ered to oo fo t o minutes  
Rai ed to 600 for 45 seconds Lo ered to oo for  
four n utes I aised to 300 for 30 seco ds Can  
nula removed leav g some bile in the grill blade

Apr l 4th cat found cold and stiff in the morning  
Postmortem done at noon probably fourteen to  
fifteen hours after death About 4 cub c e t  
meters deeply hamo rrag c serum free in abdominal

ty none in pleura or pericardum Pancreas  
showed slght p tches of hamorrhage in the s b  
tance of the pancreas a loining the papilla for  
r t o in hes on eithe side The hole organ

vas of a dull grayish pink hue and very soft O e  
g eatlv enla ged congested and ced mntous gla d  
ly n g the pancreas at its upper borde in the  
d l eno ryl c ngle Stom ch contained about

40 ub nt m ete s f the bile and lot f mucus  
Duodenum fill d ith glury mucus for a foot or  
mo e from pylo us ob u ly an acute c tar hal  
inflamm t ion The lun s ere e v cedematous

nd con ested i all lobes ith ecchym es he e  
and th e but air co tain g de d formy Other  
org s show nothing particular Death apparently  
due to acute to em a v th pancreatit s The u ne

at p stmo tem ga e a stron re ction to su r  
Microscopic examination showed xtensive are s  
of necro s but th ut hyaline ch n e Manv  
f the nucle d ot strain T l necros s i defin tely

a t e m tem the protoplasm looks coag lated as  
if t e e boiled the cells are s ollen in the l e r  
the e is a v r v m ked pure n hym tous s ell n  
not p tm t n t v together th focal ne

crosses and small hae hges There is no par  
ticular gest on the e els Part of the gla d  
ll p e rvel Secti ns of the s l englandsh  
g at edema and con dertile co gestion in the

p l l i c s Ape f the p ncreas atch d to the  
glan l h s m e c g t on some edema a d  
parti l n o i s m e a e s ith muc di nte  
g at i n f the gla d struct e and loosenn of cells

In s t o s from the p n ers i f om the  
glan l t o d by g a m s bacte ia co l d be fou d  
Cat N s April 6 1918 O bile noc lated 48  
hou s p e v uslv ith bacillu pyocyane s u d

Bile s ma kedlv alkali e Same pr cedure fol  
lo ed in Cat No 56 Cat found dead at 1 30  
a m April Immedi te p t m ort m The pa  
cre s p n k h but not p t cularly s olle On

sect there were seen numerous punctate hem r  
rhage espec lly ne th splenic end The l m  
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hilus of th l e e v ery uch e la el nd

c gested The g l l bladder pract cally empty  
In the duodenum a great deal f mu s a d a small  
hæ n h gic are in the submucosa cl se to the  
p pl l were found

M c cop c sect ns from the spl n c end sh  
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e ction but no definite necro s At the d odenal  
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there are numerous patches of moderately advanced necrosis in parts hyaline. In some areas there are also inflammatory foci and one small infarct. The lymph gland lying above the pancreas shows a very acute inflammation with great edema, catarrh, necrosis and purulent infiltration. The liver shows numerous focal necroses and also small multiple very early abscesses.

Cat No 88 April 10 1918. Ox bile inoculated with bacillus prodigiosus six days previously incubated for 48 hours and afterward kept at room temperature. With a syringe and fine needle 6 to 8 cubic centimeters of this bile was injected slowly into the gall bladder. The gall bladder did not become tense to any appreciable extent. Immediately before this cubic centimeters of a 3 per cent hydrochloric acid solution were injected through a fine needle into the duodenum. The cat had fasted for the previous 4 hours. Death followed in three hours. Immediate postmortem showed the pancreas markedly congested of a deep pink color involving body and both ends but trailing off to natural color toward the spleen and the extreme duodenal end. Bloody fluid in abdomen in quite large amount. Thorax normal except that both sides of heart were dilated. A large amount of mucus filling stomach and duodenum and upper jejunum but no submucosal hemorrhages. Mucosa of duodenum from papilla to stomach and also that of stomach of a whitish color probably due to the hydrochloric acid. Urine gave positive sugar reaction.

Microscopic section shows considerable areas of swollen cells and of possible beginning necrosis although this is not quite certain. As a whole the pancreas is normal. No bacteria are seen in sections stained by Gram's.

*Comment.* Death in this case can hardly be said to be due to pancreatic destruction but there was clearly some very acute toxic process at work sufficient to kill in a little over three hours. The congestion of the pancreas and the large amount of bloody fluid in the abdomen point in that direction. I presumably the toxin was contained in the infected bile. Whether its path of quickest absorption lay through the pancreas or through the intestinal mucosa can only be guessed.

Cat No 89 April 10 1918. Same procedure as in Cat No 88 except that bile used was that which had been inoculated with staphylococcus flavus and had been standing at room temperature for a number of days. Bile was alkaline. April 15 the cat had recovered easily and was in good condition. Abdomen opened for examination and the animal then killed with chloroform. Immediate postmortem showed nothing of note except the presence of two large swollen lymph glands obviously inflamed lying on the upper edge of the pancreas just below the pylorus. The pancreas itself was not definitely swollen but perhaps of a deeper color than normal.

Microscopic sections showed nothing abnormal in the pancreas. In the liver there were small areas

of early inflammation with small focal necroses and some hyaline thrombi.

## GROUP II. EXPERIMENTS WITH FILTERED AND STERILIZED HUMAN BILE

Cat No 90 April 13 1918. Human bile not grossly infected from a case of cholecystostomy, filtered through a Berkefeld filter to get rid of bile mucus then sterilized in autoclave for fifteen minutes. The reaction slightly alkaline. Injection of cubic centimeters of this bile filled the gall bladder with out tension. Then  $2\frac{1}{2}$  cubic centimeters of 3 per cent hydrochloric acid injected into the body of the stomach followed by  $2\frac{1}{2}$  cubic centimeters of the same into the antrum pylori. Then about 8 cubic centimeters of the bile injected into the gall bladder through a hypodermic needle this seemed to pass on into the duodenum as the gall bladder did not distend. The cat recovered well and remained in good health.

On April 10 it was chloroformed. Immediate postmortem. The pancreas near the duodenal end was fairly normal opposite the papilla and from there on to the splenic end it was definitely thickened and the lobules stood out prominently. No areas of fat necrosis. The gall bladder contained clean looking bile and mucosa was healthy. The common duct was not dilated. The duodenum was normal. The urine showed a marked quantity of sugar. Otherwise there was nothing particular to be found.

Microscopic sections show large areas of necrosis in the pancreas with beginning hyaline change. The central area around the ducts is especially involved while the periphery is often preserved. In some parts especially close to the papilla there is acute parenchymatous degeneration but no necrosis. Sections of the liver show focal necroses.

*Comment.* Note the effect of sterile bile deprived of its mucin and consequently containing a disproportionate amount of bile salts. Note also the lack of high pressure from the gall bladder side and the resistance of the sphincter provoked probably by the hydrochloric acid. Also note the presence of marked microscopical changes without obvious gross lesion.

Cat No 91 April 15 1918. Injection of human bile into the gall bladder with a syringe and a large needle. Bile the same as that used in previous experiment. After expressing gently most of the bile found in the gall bladder the bile used in the experiment was injected and the gall bladder was distended. This was followed immediately by the injection of  $\frac{1}{2}$  cubic centimeters of 3 per cent hydrochloric acid into the duodenum close to the pylorus which was then milked gently down toward the papilla then immediate injection of  $\frac{1}{2}$  cubic centimeters of hydrochloric acid as before followed by 4 or 5 more squirts of bile into the gall bladder using alto ether 13 cubic centimeters of bile. The gall bladder was not emptied between the injections.



but was relaxed somewhat so that some bile clearly escaped into the duodenum or the pancreas. The pancreas examined immediately upon opening the abdomen was seen to be of a pale pinkish color. Examined again at the close of the experiment it was found much deeper in color and the blood vessels standing out prominently. There were also one or two small ecchymoses. One area in the body of the pancreas stood out pale by contrast with the deep red of the rest of the organ.

The cat was rather ill for two or three days after the operation but then regained normal health. On May 30 it was chloroformed. The organs were all apparently normal. The pancreas was moderately pink but not thickened or otherwise abnormal. There was nothing else of note. No sugar as found in the urine.

Microscopic sections show that the duodenal end of the intestine is covered with necrosis with hyaline change. In two places apparently small infarcts. At the splenic end definite necrosis but in some areas as a melting of cell outlines giving a sort of boiled look to the tissue. Considerable congestion. In the liver very extensive fatty change chiefly in the peripheral lobules.

Cat No 9. April 7, 1918. Injection of 3 cubic centimeters of human bile filtered at distillate but stirred for past week at room temperature. Calculated with drop of hydrochloric acid. Injection of bile previously alkaline made definitely acid into gall bladder after partial exposure of the finger-fibre in the gall bladder immediately followed by injection of 3 cubic centimeters of 3 per cent hydrochloric acid into the duodenum just below the pylorus.

May 31 chloroformed. The cat had been ill since the operation. Necrosis and the other organs were found to be normal.

Microscopic section shows that the duodenal end normal. Pancreas except that in certain areas cell outlines are fused nuclei stain poorly and the tissue generally looks as if it had melted. The necrosis seems to be definite parenchymatous degeneration of the necroses. In some sections the necrosis are quite extensive.

At the splenic end the appearances are similar to those in the duodenal end. In the nodule opposite the papilla the cells are a good deal of small cell infiltration and also of young fibrous tissue chiefly between the acini. Some areas are quite solidly composed presumably a replacement of former areas of necroses.

These two experiments show that the coincidence of bile deprived of its mucin with sudden pressure from the gall bladder side and increased acidity in the duodenum is not always sufficient to bring about injury to the pancreas. Doubtless there must occur a particular combination or sequence of these conditions and activities to cause pancreatitis.

### GROUP III. EXPERIMENTS WITH SOLUTIONS OF BILE SALTS

Cat No 94. May 31, 1918. A solution of sodium glycocholate was made in salt solution of a strength corresponding to the strength of the salt in human bile and a few cubic centimeters were injected through a fine syringe into the gall bladder after aspirating the bile present in it. The gall bladder was not put under tension by the injection. The animal seemed unaffected by the operation. It was chloroformed after 48 hours and postmortem showed the absence of any gross change in the pancreas or other organs. On microscopic examination however there was found extensive mass necrosis of the parenchyma with loss of cell outlines fusion of the protoplasmic loss of nuclear staining but without hyaline change. In the liver fairly numerous focal necroses were found.

Conclusion. The gross appearance of the pancreas was apparently so normal that the discovery of extensive cellular necrosis in the microscopic sections was a great surprise. The fact has been noted by Polya. The necrosing effect of the glycocholate in this instance is opposed to the observations of Flexner who found that the injection of this bile salt into the pancreas caused but little disturbance.

Cat No 96. May 31, 1918. A solution of sodium taurocholate in the strength normal in human bile was injected into the gall bladder after aspiration of its bile using about 6 cubic centimeters in three lots separated by an interval of some ten minutes. The animal did not appear to suffer from the operation. It was chloroformed after 48 hours and postmortem showed the pancreas apparently normal save for slight congestion but the remarkable finding was of fat necrosis stretching along the upper margin of the pancreas almost to its entire length. Here again as in Cat No 94 the comparatively normal gross appearance of the organ is belied by the discovery of extensive necrosis in the microscopic sections and moreover the necrosis as quite as advanced as the splenic end as it is in the neighborhood of the papilla of Vater. The picture as similar to that seen in sections of Cat No 94.

This case would seem to prove the possibility of the occurrence of fat necroses without gross inflammatory obstruction of the main excretory ducts also the possibility of mild grades of pancreatitis with symptoms so slight as to escape observation at any rate in the animal. It suggests the likelihood that there occur cases in the human of mild pancreatic swelling accompanied even by fat necroses later absorbed giving clinically indefinite symptoms of epigastric pain lasting only for a short while such as we see so

frequently in practice and of which the cause so often remains undiagnosed. Both these operations (Cats No 94 and No 96) indicate the possibility and indeed the probability that there occur in the pancreas isolated or even extensive necroses resulting from the entrance of bile into the pancreatic duct which go on quietly to replacement fibrosis ending in a moderate sclerosis of the organ which is not sufficient to interfere materially with its function. The condition is found not infrequently at autopsies in patients who have died from other causes without there being noted in the case histories anything suggestive of a previous pancreatitis. Whipple has called attention to this fact in his animals and has emphasized the extraordinary capacity of the pancreas to recover in this way from extremely serious necrosing lesions.

From a review of the experiments related above certain outstanding facts may be deduced. Of these the main one is that the lesions produced in the pancreas by these methods of experimentation were brought about entirely through the action of the common duct sphincter combined usually but not always with some increase of pressure in the biliary system behind the sphincter. That this increase in pressure need be very slight indeed but little over normal bile pressure in the common duct or may be even quite absent is seen in the results obtained in Cat No 87 also in Cats No 90, 92, 94 and 96. I would suggest indeed that this is the ordinary mechanism at work in human cases even when gall stones are present. In these animals there was no question of any mechanical obstruction to the outflow of bile into the duodenum. The obstruction was purely a physiological one. While the application of hydrochloric acid to the duodenal mucosa will definitely stimulate the sphincter to a heightened resistance it is obvious that such hyperacidity is not necessary for the forcing of the bile into the pancreas. Many lesions of the organ were produced without it.

The second fact is that we have been able to produce in this way most of the main types of lesions in the pancreas found in

clinical practice. Cat No 86 is an example of the acute fulminating hemorrhagic necrosis of the gland with death inside the hour. Cat No 90 is an example of the generalized increase in size and hardness of the organ so frequently found at operation with or without fat necrosis. The amount of necrosis in the pancreatic tissue is not so great as to cause sequestration and it is without doubt replaced gradually being aseptic by fibrous tissue. This would represent the ordinary cure of pancreatitis of that grade of severity. Cat No 96 represents the very mild type of the disease going on to cure with a small amount of fat necrosis spontaneously reabsorbed. Cat No 84 is an example of subacute pancreatitis with diffuse thickening and some fat necrosis ending in death after two weeks and with extensive necrosis of the parenchyma of the pancreas in microscopic sections.

Another interesting point concerns the immediate cause of the necrosis of the pancreatic parenchyma. Some have stated that in whatever way the initial cell was destroyed further destruction must be caused by activation of the trypsinogen in the pancreas presumably by the introduction of enterokinase from the duodenum or possibly by some other activating agent such as calcium derived from the blood, the bile or inflammatory exudate. The experiments however above recorded and also those carried out by previous observers seem to show very clearly that the necrosis of the pancreas is the direct result of the action of substances entering the duct of Wirsung such as the bile salts unmingled with bile colloids or such as artificial gastric juice or a whole series of acids and strong alkalis. Recent observations of Tatum (26) and Bradley and Taylor (27) show that bile or its salts has a very marked cytolytic effect on the cells of various organs and that this disintegrating effect is quite distinct from autolysis; that is that it is not due to the activation of enzymes by bile or to a co-ferment in bile but represents a straight destructive effect presumably of a chemical nature. The microscopic picture of diffuse parenchymatous necrosis most marked in the center of lobules surrounding the ramifying ducts and the hyaline

nature of the necrosis differing markedly from the picture seen in postmortem auto-digestion would apparently suffice to prove this contention. Thus the necessity of accounting for the entrance of an activating ferment through the papilla and into the pancreas falls to the ground though it need not be denied that activation and consequent autodigestion may occur secondarily and so increase the original necrosis caused by the entrance of bile. The theory of Williams and Busch (11) assuming the flow of duodenal contents containing enterokinase back through the papilla dilated by the recent passage of a calculus would provide the conditions for activation of the trypsinogen. In a like manner the mucous currents described by Mr. Bond (8) (who found carmine granules given by mouth appearing in the bile from a cholecystostomy—an observation which by the way has been confirmed by the writer in one case out of three) might carry enterokinase up into the common duct. As a matter of fact the writer believes that the extent of necrosis is determined at the very outset of the disease by the grade of virulence and extent of permeation of the noxious agent very much as in acute osteomyelitis the size of the sequestrum is fixed in the first few hours of the infection. It is possible of course that succeeding invasions of bile may increase the extent of necrosis.

A few other points of interest may be noted without discussion in this place. Liver necroses of the type now well known as focal necroses (Fischler 9) occurring in the course of pancreatitis were found with great regularity both in fatal and in light cases and were present within 20 minutes of operation.

The severe cases with early death were all in the series in which infected bile was used. Sterilized mucin free bile and the bile salts in solution caused it is true necrosis of the gland but of a degree easily consistent with recovery while the infected or bile almost regularly caused early death usually with occasionally without severe lesions in the pancreas. Possibly the pancreas formed a route of particularly easy absorption

There is here an interesting comparison to be made with the cases of sudden death described by Symmers (30) in which moderate pancreatic necrosis was almost the only lesion found. Note especially in this regard Cats Nos 81 8 85 87 and 88. Fat necrosis (see Cat No 90) is possible without acute changes in the pancreas of a reactionary inflammation and without infection.

The histological lesions correspond accurately with those produced by the injection with a syringe of bile acids alkalis and other irritants as carried out by Flexner Pearce Hlava and a number of other observers.

That alteration in the constitution of bile which once it is forced into the pancreatic duct will set up necrosis and inflammation is fairly well known. It is such as to leave the bile salts particularly the taurocholate in undue strength whether this is accomplished by filtration or possibly by the action of bacteria. But the exact combination of circumstances under which such a bile so altered as to be irritating to the pancreatic cell is driven into the pancreatic duct is still somewhat unclear. I imagine that normal bile must frequently be forced into the pancreas by the action of the sphincter without doing any harm or causing any symptoms. The conditions for actual damage to be done must pretty certainly be three: first a change in bile composition increasing the proportion of bile salts; second undue resistance perhaps often amounting to spasm of the common duct sphincter; and third abnormal rise of pressure in the biliary system behind either in the gall bladder or in the common duct.

Our problem therefore is to discover in the facts of clinical experience circumstances fulfilling these postulates. Here we come on to uncertain ground. It is probable that hyperacidity may have a good deal to do with it. Symptoms indicating hyperacidity are frequently found in the previous history of patients with pancreatitis (Egdahl 14). Certainly the injection of hydrochloric acid into the duodenum or even into the stomach (Oddi) will cause a spasm of the sphincter. In man we are still unacquainted so far as I know with the condition of the duodenal

contents as regards the length of time which is necessary for neutralizing the acid chyme of the stomach. In alcoholics anyhow and in patients who have duodenal ulcers it would seem probable that the duodenal contents might remain acid for some time and in these two classes pancreatitis is rather frequent. One recalls in this connection three cases published by Dr William J Mayo in which acute pancreatitis was present without gall stones anywhere but with in each instance a duodenal ulcer situated close to the papilla presumably causing hyperacidity.

In the second place that change in bile which results in a high concentration of bile salts and a diminution of bile mucin is probably brought about by the effect of gall stones especially when associated with inflammation. In infected bile it is pretty certainly not the bacteria acting in their infecting capacity that cause the pancreatic lesion but rather the chemical change in the bile produced by the action of bacterial growth. This at least was strongly suggested by the work of Flexner of Carnot Hlava and others and the present experiments in which sterile bile and a solution of sodium taurocholate caused the lesion equally with infected bile tend to confirm this view. I am unacquainted with any work upon the chemical composition of infected bile but it may be presumed that the action of bacteria is to precipitate the mucin of bile and indeed we see the evidence of it in the shreds observed in the bile in cases of cholecystitis and cholangitis. If this is the case it is probably contrary to the assumption of Flexner that the relative proportion of the bile salts is increased. I may add that Dr Harding Associate Professor of Chemistry in McGill University is beginning work along this line. It must be pointed out however that the effect of bacteria upon the bile seems to increase very greatly the destructive effect of that bile upon the pancreas and while this is still probably due to some chemical change in the bile it seems likely that there come into play in addition to the bile salts new substances possessing necrosing properties.

It may be noted also that any obstruction in the cystic duct would likely deprive the

bile of a part of its mucin content normally provided by the gall bladder mucosa and in such cases theoretically at least the occurrence of a pancreatitis may be rendered more likely.

In the third place the condition of increased pressure in the biliary system is presumably brought about partly by an increased resistance of the sphincter set in motion by hyperacidity or by neighboring ulcers partly by a sudden blocking of the cystic duct by stone or inflammation and finally perhaps by any unusual increase in the amount of bile secreted by the liver. The effect of a full meal two or three hours after which as we see in so many case reports the attack of pancreatitis is apt to come on may be in the direction of increased bile production rather than in that of increased pancreatic secretion.

#### TREATMENT

In conclusion I would like to say a few words about the bearing of these experiments upon treatment. Accepting this conception of the action of the sphincter I think it may be concluded that the surgical treatment of pancreatitis must chiefly lie in a prevention of any further retrojection of bile into the pancreas. The damage already done to the organ will often be cured by the processes of nature absorption replacement or even sequestration. On the other hand if gangrene abscess or total slough has occurred it may require a direct attack upon the pancreas itself. But to prevent recurrence or extension the cardinal point would seem to lie in the prevention of any heightened pressure in the biliary system and secondly in the restoration of an altered bile to its normal chemical condition or of an infected bile to sterile bile. This can only be done by a drain in the gall bladder or in the common duct. Whether one should do a cholecystostomy or a cholecystectomy with drainage of the common duct is still a moot question altogether apart from the condition of the biliary passages and the situation of gall stones in the individual case. Without pronouncing one way or the other in this matter I would like to point out that in my opinion the essential thing lies in prolonged drainage that is prolonged

prevention of any rise in pressure in the bile system. This is more completely done by a drain in the common duct than by one in the gall bladder and possibly explains what we now are inclined to believe is the case that a cholecystectomy gives a better result than a cholecystostomy. I still think as suggested in a paper a few years ago that in certain cases the object of preventing a rise of pressure in the biliary system for a long time or permanently would be best secured by cutting the common duct sphincter. The after history of a duodenostomy for removal of stone which always cuts the sphincter seems to be very good. Such cases might form a middle class between those in which the gall bladder is apparently normal and those in which it is so diseased as to demand removal. But in any case if the pancreas is materially affected we must assume that nature will require at least three or four weeks and often two or three months of protection in order to complete her repair work in the pancreas. I therefore adopt as a rule prolonged drainage of bile from one to three months in all cases of pancreatitis save the very lightest. And I may add that a recent investigation into the late results of our pancreatitis cases at the Royal Victoria Hospital has brought out in a very striking way the value of a drainage kept up for over three weeks and up to three months while on the other hand it has shown that a drainage of two weeks and less is followed by a large proportion of recurrences of the pancreatic attacks.

Parentetically accepting for the present the conclusion of Judd (31) that a cholecystectomy will more certainly cure pancreatitis than a cholecystostomy one may hazard the guess that the reason lies in the cutting out of the only muscular force of any strength in the biliary system thus preventing the rise in pressure associated with the contraction of a muscular organ and substituting the big capillary system of the liver capable of absorbing a considerable amount of back pressure when brought on slowly as would be the case with the continued resistance of the sphincter.

The interested reader should consult in

this connection the very excellent clinical and experimental work done in the last two years by Dr Judd and Dr Mann of the Mayo Clinic (31 33 34 and 35).

The opinion of some surgeons to the effect that a direct attack in the acute and sub acute lesions should be made on the pancreas itself with the idea of draining that organ by incisions through its capsule or by blunt poking into it is I think an erroneous one founded on a misconception of the pathological condition. One cannot drain a diffuse necrosis. Only in the cases in which such an interference can evacuate collections of pus or of septic turbid fluid representing the liquefaction of necrotic tissue plus reactionary exudate can such a procedure be justified. Whipple and Goodpasture (32) have shown that the reactionary peritoneal exudate in acute pancreatitis has protective value and the frequent recovery without operation of cases of a degree of severity less than that of the hyperacute or fulminating form tends to confirm this view. Whipple and other investigators have shown as a matter of fact the great capacity of the pancreas to repair damage done to the organ and it is possible that an excessive zeal in the operative attack upon the pancreas itself has pushed over the brink some cases that might otherwise have got well.

Practically speaking it is the writer's opinion that surgical intervention should run along the following lines. In hyperacute or fulminating cases in which death is obviously likely to occur within the first twelve to twenty four hours the patients being in collapse it is better to wait the shock of operation may turn the scale against them and it is impossible short of cutting out all or most of the pancreas to prevent that absorption of split products from the necrosed tissue of the organ which is the immediate cause of death. These patients cannot be saved. If they do survive it is because the dose of poison stops short of the fatal amount, and not because incisions into the pancreas divert to the exterior a sufficient amount of the poison to turn the balance. It is only fair to add however that the administration of ether in animal work seems to

mitigate the toxic effects of split product absorption

In all cases of less severity it is advisable to operate. In the acute cases the object is not to remove peritoneal exudate which is rather protective than otherwise or to coffer dam the pancreas (an impossibility it seems to me) but rather and chiefly to drain the biliary system and so prevent further entrance of bile into the organ. If there is a collection of fluid in the pancreas this may be incised and drained otherwise the pancreas should be left alone. The type of operation on the bile passages will vary according to degree of involvement of pancreas.

If the latter is only slightly enlarged and hard and the gall bladder is comparatively healthy a cholecystostomy may be done and the bile drained for not less than three weeks. If the pancreas is moderately large and hard bile drainage should be kept up from four to six weeks. If it is very large and hard drainage should be maintained for three months with the alternative (proposed but not established on a definite clinical basis) of a cutting of the sphincter of Oddi through an opening in the duodenum. In all these cases the gall bladder should be removed if in the opinion of the operator it is likely to remain a source of infection in which case the common duct should be drained. In the acute cases with the patient in a precarious condition the least degree of interference is probably the best and that would obviously consist in a cholecystostomy.

In the chronic sclerosing type of pancreatitis following late after a severe acute attack with fatty stools and glycosuria and occasionally jaundice I believe on theoretical grounds that it would be wise to cut the sphincter of Oddi in order to make quite sure that there will be no interference with the easy exit of bile and of whatever small amount of the pancreatic external secretion that may still be produced. A small amount

of pancreatic juice will suffice for digestion, and the presence of bile in the intestine is necessary to fat absorption. In one such case in the writer's experience a chronic sclerosis of the gland ended in rapid death from a hyperacute pancreatitis. Jaundice is usually absent in such cases but if present and of long standing and apparently due to obstruction by the enlarged head of the pancreas a cholecystenterostomy would clearly be better than cutting the sphincter.

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## TREATMENT OF PURULENT ARTHRITIS BY WIDE ARTHROTOMY FOLLOWED BY IMMEDIATE ACTIVE MOBILIZATION

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H. ry P. f. f. h. U. ty f. (C. D. f. l. H. l. M. l. ry H. l. l. (B. l. m.)

NO therapeutic law has been more firmly established than that which has made immobilization obligatory for every joint injury from the mild to the most severe. Nevertheless we all know its consequences: muscular atrophy which is rapid for certain muscles such as the femoral quadriceps and tissue of the joint. Also we know that such complications when once established are extremely tenacious and that frequently they do not yield completely to varied and very prolonged physiotherapeutic treatment. Even in the more fortunate cases it is necessary to continue such treatments for some month before getting the required results. Immobilization has been considered a necessary evil. It alone was believed to be capable of stilling the pain and obviating aggravation of the lesions of preventing irritations and inflammations. In the case of purulent arthritis there was the stronger reason for carefully placing the joint at rest in order to avoid dispersion of the germs and extension of the infection.

It must however be recognized that in recent years there has been a mild reaction against systematic and prolonged immobilization. Many urgeons are now of opinion that for non-infected articular lesion at least the joint ought to be mobilized as soon as possible. Although vague this phrase is significant and shows a certain evolution of ideas produced by the force of event.

It is now some years since my attention was directed to this problem and I have freed myself by degree from practicing the law of immobilization. I commenced with evacuatory punctures to drain traumatic effusions of the knee, hemarthroses and hydroarthroses and by making the patient walk immediately. Not only could they do this without any difficulty but their lesion cured in a few days without leaving any trace. My method of treating traumatic effusions by puncture

followed by immediate movement was rapidly adopted by practitioners dealing with industrial accident owing to the rapidity and perfection of the recovery and also owing to its great simplicity.

Since the war the great frequency and infinite variety of articular lesions gave me the opportunity of applying this new method on a large scale. In the simplest and most severe conditions I have used immediate active mobilization after the operations for penetrating joint wounds with or without an included projectile and for all varieties of intra-articular war fractures. I have not confined myself to non-infected fresh cases. I have also treated cases of purulent arthritis and it is perhaps in these difficult infected cases that the method has given the most astonishing success. But the objects pursued differ. In simple lesions immediate active mobilization obviates atrophy and ankylosis. In purulent arthritis it seeks on the contrary to drain the articulations. In the first case the joint must be completely closed in the second it must be left widely open.

A word as to the technique. It is practically the same whether the wound is aseptic or infected. In the case of recent injuries we commence by excising the soft parts of the wound proceeding with the eventual equilibrium of the fracture area, extracting projectiles and hermetically closing the joint. In purulent arthritis on the contrary we must first execute an arthrotomy and leave the wound largely open. But starting from this movement we always proceed in the same way for mobilization.

The expression immediate active mobilization must be taken in its literal sense. The mobilization must be *active* that is to say made by the patient himself by muscular contractions. The movements ought reproduce the essential normal movements ex-

tension flexion and rotation. The goal to be reached is to restore the physiological function of the articulation as much as possible and in the case of the knee this function is walking. When complete functional restoration is not immediately possible for instance in case of very extensive fracture we must be contented with causing the chief active movements to be executed with the patient lying down.

Active mobilization cannot in any way be replaced by a *passive* mobilization which does not call into play either the muscles of the limb or its nutrition and which tends to restore mobility alone.

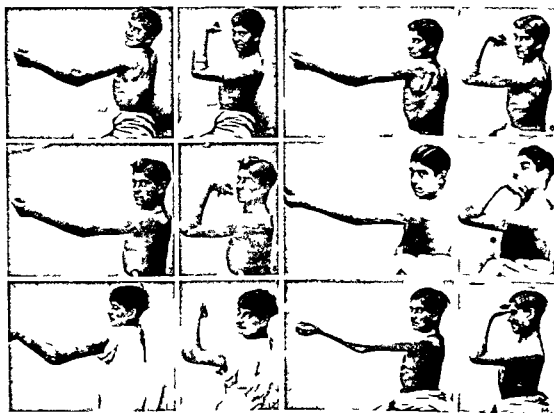
Mobilization must also be *immediate* that is commenced as soon as the patient awakens from anaesthesia. The patient must not be permitted to rest. The movements must be pushed to the maximum in every direction and must be kept up so to speak uninterruptedly. The treatment requires from the patient an effort which he will only make if



Fig. 1. Case. Roentgenogram taken on admission. Penetrating wound of left elbow by bullet with fracture of olecranon process. Pulverulent arthritis.

Fig. 2. Same as Fig. 1.

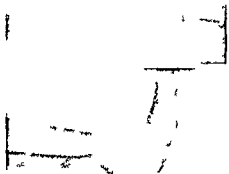
he is kept at it all the time. He therefore needs supervision by a personnel in touch with the necessities of the treatment.



Figs. 3 and 4. Case. 1. T. 1. after arthritis. Figs. 5 and 6. After 15 days after arthritis. Figs. 7 and 8. After 15 days after arthritis. Figs. 9 and 10. After 15 days after arthritis.

Fig. 11. After 15 days after receipt of wound. Fig. 12. After 15 days after receipt of wound. Fig. 13. After 15 days after receipt of wound. Fig. 14. After 15 days after receipt of wound.





ll C C m j f t t t t R t  
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Active mobilization is always possible. It becomes more or less easy according to the extent of the lesion, the courage of the patient and his aptitude in directing his efforts to the muscles which must be contracted and not wasting his strength in contracting other muscles than those necessary. Movements become easy according as they are repeated.

Active mobilization is not painful in the true sense of the term except when it displaces large bone fragments and in such a case it is contra indicated. But the movements are laborious and call for effort. It is found that a patient treated by active mobilization uses his limb in a variety of non

prescribed ways which he would not employ if the movements were painful. Many have stated that when a little pain is felt in periods of rest the best way of stopping it is to resume the movements.

Active mobilization gives the most surprising result in purulent arthritis. I do not hesitate to assert that against this formidable infection the new method is more efficacious than any of the means hitherto at our disposal.

In applying mobilization to the treatment of articular suppurations my chief aim was to realize a satisfactory drainage after arthrotomy. We know that efficacious drainage of a joint by the ordinary means is an utopia. No kind of tube, no system of tampons, no means of irrigation obviates retention nor stops the progress of infection. And it is on account of this insufficiency of drainage that arthrotomy has been almost abandoned and replaced by resection. But I have always been under the impression that to resect for the purpose of drainage alone is to go too far and I have endeavored to empty the joint by compression thanks to active movements. My earliest attempts convinced me. When a suppurated articulation has been opened by a large uni or bilateral arthrotomy (a U arthrotomy is never necessary) this is what is observed. At each extension and at each flexion the synovial surfaces are forced together by muscular contraction and pressure.



Fig 18 C I t t f m t d  
f t  
Fig 9 l M m t b f th p l t l

Fig 1 d M m t m th ft c pt  
( f k )

expressed often in the form of a jet. When the movements are very extensive and the muscles contract more vigorously the expression of pus is so much the more complete. If the movements are repeated a sufficient number of times the secretions are eliminated in accordance with the movements retention is prevented and articular drainage profoundly influences the local and general conditions. Locally suppuration evolves like an ordinary abscess but slowly. It lasts for a few weeks abundant at first then less and finally disappears completely. During this period the arthrotomy opening or openings cicatrize. A species of fistula persists which closes from time to time and must be periodically opened. Oedema of the periarticular tissues diminishes very rapidly and the tissues remain supple. Periarticular abscesses are so to speak unknown.

With regard to the general state it is rapidly modified. From the commencement of active mobilization fever falls not completely as the patient may show 38° C for some time. But the feverish aspect disappears such patients do not look like badly infected cases.

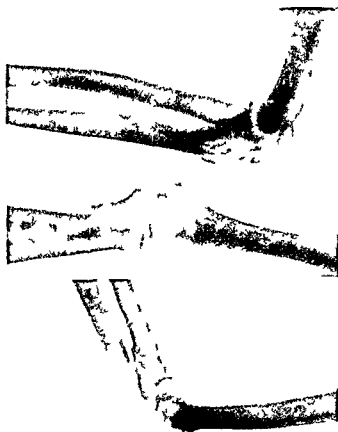
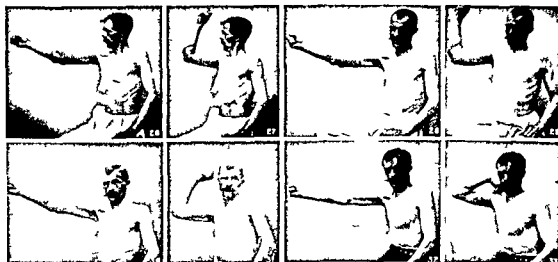
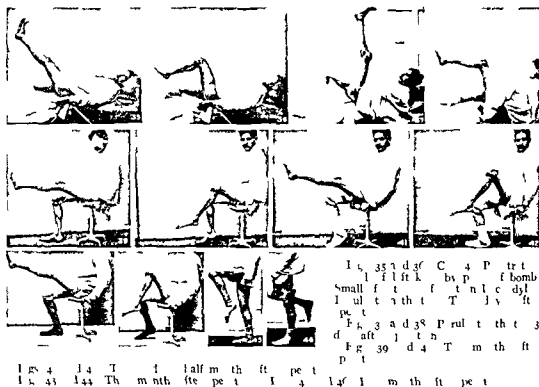


Fig. 3. Case 3. Compound fracture of olecranon and fracture of lower part of ulna taken on admission. Figs. 4 and 5. Case 3. After equestrian.



Figs. 26 and 27. Case 3. Two days after operation.  
Figs. 28 and 29. Six days after operation showing beginning of infection.  
Figs. 30 and 31. Ten days after operation. Purulent arthritis.  
Figs. 32 and 33. Four months after operation.  
Fig. 34. Six and one half months after operation.





Drainage is therefore realized in an ideal manner without a tube and without irrigation of any kind. I am of the opinion that irrigations are more harmful than useful.

Drainage was my aim at first. But I obtained more. I have obtained preservation of the articular mobility. Unquestionably we must consider the recovery of a purulent arthritis with ankylosis as satisfactory and be thankful that the patient has escaped resection, but it is evident that a mobile joint is much better than the best kind of ankylosis.

Owing to the movements the arthritis has but little effect on the musculature. The quadriceps, which rapidly atrophies in purulent arthritis of the knee, remains astonishingly vigorous and in the final reckoning there is but a negligible degree of atrophy.

Preservation of the articular mobility seems due to the fact that the perfect drainage limits infection to the synovia alone and prevents its propagation to the cartilage and bone. This is what is observed.

If the procedure is followed in the manner indicated, mobility of the joint will always be preserved. From the moment that suppura-

tion notably diminishes we sometimes see a tendency to stiffness. This is why I now partially and progressively close the arthrotomy wound from this moment and only leave such opening as is strictly necessary for the discharge of pus which is still forming. Proceeding in this way, mobility will be perfect and absolutely normal in the great majority of cases, no matter what the causative microbe may be. The limb will show no functional disturbance after an infection as terrible as purulent arthritis was formerly considered.

In my earlier cases there remained sometimes a slight defect in flexion or extension. But I have the impression that according to one becomes familiar with the method, we more and more regularly obtain complete successes.

In purulent arthritis still more than in non-infected lesions it is difficult to realize the possibilities of active mobilization. It is so contrary to classical ideas that we must see the patients move their limbs in order to understand. The truth is that movements are perfectly possible in purulent arthritis treated



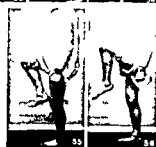
Figs 47 and 48 Case 5 Multiple wounds by pieces of shell Purulent arthritis of left knee from a small wound in the popliteal hollow Twenty five days after receipt of wound One day after arthrotomy

Figs 49 and 50 Seven days after arthrotomy

Figs 51 and 52 Thirteen days after arthrotomy

Figs 53 and 54 Twenty five days after arthrotomy

Figs 55 and 56 Six weeks after arthrotomy



by arthrotomy to the same extent as in non infected articular lesions treated by excision of the damaged tissues and total primary suture. Movements are no more painful in the first case than in the second. They are equally laborious in the two cases. True pain appears only when the drainage is insufficient and then it becomes necessary to drain more completely to cause an immediate cessation of pain. Whenever a patient complains of pain especially in the popliteal space it is almost certain that there is retention. The patients themselves soon learn to recognize this cause of pain and stop it by means of some movements.

In order to be convinced that movements are not painful there is nothing better than

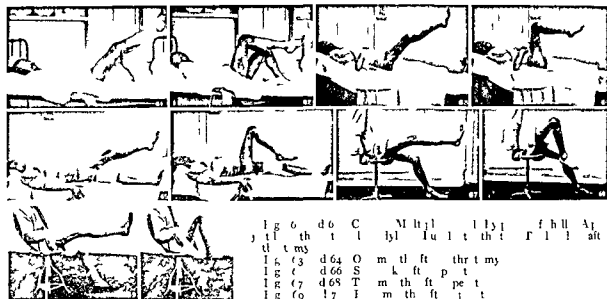
to observe a patient when he does not know he is being watched. It is then seen that far from fearing movements as was the case with the classic treatments he constantly moves the joint without apparently being concerned about it or preoccupied with the position of the limb. This fact easily verified proved quite clearly that if the articulations were even feebly painful the patient would instinctively keep the part at rest.

Patients with purulent arthritis of the knee can walk early even before cicatrization of the arthrotomy wound. It is the same with purulent tibiotarsal arthritis. It is a curious experience to see them walk with the joint widely open expelling a little pus at each step.



Figs 57 and 58 Case 6 Multiple wound of both leg and hip by pieces of grenade One penetrating wound of left knee Purulent arthritis Three weeks after arthrotomy

Figs 59 and 60 Four months after arthrotomy



With regard to the question whether immediate active mobilization is applicable to cases in which purulent arthritis accompanies an intra articular fracture it can be answered affirmatively. As in non infected lesions mobilization can be effected in purulent arthritis with fracture on condition that there is no fear of displacing the fragments. If there is movements are contraindicated because they might dislocate the joint.

A second circumstance which render this method inapplicable is primary destruction of the ligaments and of the articular capsule. When the means of union have disappeared it is evident that the joint can no longer be mobilized by muscular contraction. But it is well to know that a partial destruction of the means of union does not render the method quite inapplicable.

I give here the history of some cases of purulent arthritis of the elbow knee and instep due either to the diplococcus staphylococcus or the streptococcus with or without intra articular fracture. These have been treated by simple arthrotomy followed by immediate active mobilization without any other means of drainage and without lavage. In all these patients drainage has been perfect the temperature has not been high the general state has remained excellent infection has been confined to the synovia there

has been little or no atrophy and articular mobility has been integrally preserved.

CASE 1. Van D. Auguste. 18 years old. Shot wound of the left elbow with comminuted fracture of the coronoid process. Bilateral arthrotomy with cleavage and excision of soft parts. Total closure of the wound.

The patient began to move his elbow two hours after operation. After a week extension and flexion were effected without difficulty and in a wide extent. Recovery continued and the movements became almost normal then to a day the seventh week after an accidental torsion of the elbow hemarthrosis was produced then peri articular abscess and finally a purulent arthritis. An external arthrotomy was done. Pus showed staphylococci.

Movements were continued without interruption. They soon resumed their primary extent which had been much reduced owing to the infection. One month after the arthrotomy the secretion was cleared. The wound had been partly closed after 18 days. Two and a half months after infection the movements became very extended. There still persists some thickening of the epiphyse (Fig. 1 to 14).

CASE 2. I. Alph. 18 years old. Grenade wound of the external face of the right elbow. Loss of substance of the external condyle and of the cupula of the radius. No projection included.

Excision of the musculocutaneous and axillary fragments. Total closure. Active immediate mobilization. Redness and swelling followed. Wound reopened. Movements continued and sero sanguineous fluid expressed. On the next day the fluid was purulent. Staphylococci. Movement continued though with difficulty and extended. Temperature did not exceed 38.4.

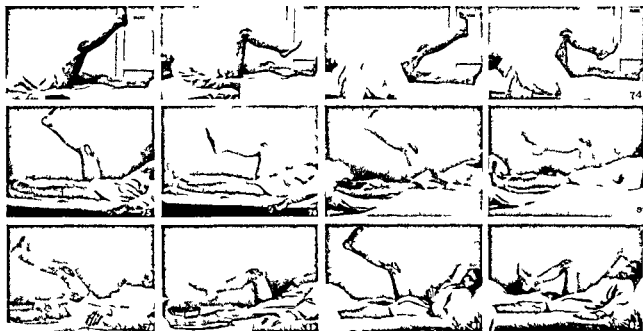


Fig. 71 and 72 Case 5 Ap. f. hell n th right knee with fracture of the tibial epiphy. I. rulent arth it 74 hours after arthrotomy

Figs 7 and 73 Three day after perat n  
Fig. 74 and 75 Lift en l v after operat n  
Fig. 7 and 78 One month after operat n  
Fig. 9 and 80 S eek aft r perat n  
Fig. 8 a d 8 P v month aft r perat n  
Fig. 83 and 84 C e o C m j und f r a t i r f j  
Three months aft operati n



us by j f hell Infecti n Purulent arthritis

After 1 month without any irrigations secretion was reduced to a minimum and the wound began to close. The extent of the movements increased each day and they were easily accomplished although they were more difficult after the night's rest. It required 4 months for definite closure of the wound. At present all movements are complete. The musculature is superb (Figs. 13 to 15).

CASE 3 R. Victor Right elbow traversed by piece of bomb. Olecranon shattered and comminuted fracture of cubitus.

Internal arthrotomy. Complete clearance the whole olecranon removed. Lateral ligament of joint and complete closure. Immediate active mobilization which the patient does very well. By the third day a right angle of flexion was reached with complete extension. But by the sixth day there was swelling and redness and the movements diminished. Then some pus squirted between the suture. Wound reopened. Movements continued without interruption with very complete expression of pus. No fever and the general state excellent. Streptococci in pus. Cicatrization after 3 1/2 months of suppuration. The definite results showed that movements of the elbow are intact and the muscle in excellent state (Figs. 3 to 14).

CASE 4 L. Henri Penetrating bomb wound of left knee. The projectile entered the external side

of the knee through the articulation producing a comminuted fracture of the external condyle and lodged higher up in the femur.

External lateral arthrotomy. Excision of soft parts. Clearance of the bone area. Total closure. Immediate active mobilization. From the second day flexion reached a right angle and extension was complete. There was a heavy hemarthrosis discharging between the sutures during movements. On the sixth day the temperature increased, the knee swelled and became painful. Movements were less extensive. Arthrotomy wound reopened. Discharge of a large quantity of thick pus. Wound was left open and movements continued. In the pus large numbers of small diplococci and staphylococci were found. During the following days the discharge being insufficient an internal arthrotomy was added. From this on the drainage was good and the movements increased in amplitude.

After 4 weeks the secretion took a serous aspect and notably diminished. The two wounds were partly closed. The remaining part of the external wound closed very rapidly and did not reopen.

Examination 4 1/2 months after injury shows walking absolutely normal. Integral mobility and the muscles in excellent state (Figs. 33 to 46).

CASE 5 H. Louis Multiple shell wound of the limbs and abdominal wall. A projectile deeply em-



ROENTGENOGRAPHIC DIAGNOSIS IN RENAL TUBERCULOSIS<sup>1</sup>

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 From the Mayo Clinic and Mayo Foundation

SEVERAL articles have appeared in European literature in recent years concerning the value of roentgenographic findings in the diagnosis of renal tuberculosis. Probably the most comprehensive of these is one written by Burchard who has made a thorough review of previous literature on the subject. In this country the method has had only limited use and its importance does not seem to have been appreciated by American observers. Articles referring to the subject have been published by Krotoszyner and by one of the writers (Braasch).

The roentgenographic data in renal tuberculosis are regarded of such importance at the Mayo Clinic that it is a rule to make a complete roentgenographic examination of the urinary tract in every case in which renal tuberculosis is suspected. The frequency with which positive data may be obtained in the roentgenogram is evidenced by the fact that in the years 1916 and 1917 131 patients were operated on for renal tuberculosis and roentgenographic examination of the urinary tract had been made of all. Of this number positive shadows suggestive of renal tuberculosis were found in thirty patients a percentage of 23. It may be stated therefore that approximately one out of five patients with renal tuberculosis will have positive roentgenographic data of definite diagnostic value. Such data are of particular value in conditions as follows:

1. When because of the contracted condition of the bladder or impassable stricture of the ureter the cystoscopic findings are inadequate.
2. When the cystoscopic findings are not typical of renal tuberculosis.
3. When the clinical findings are not suggestive of renal tuberculosis or of any involvement of the urinary tract as may occur with a closed tuberculous pyonephrosis.
4. In the presence of bilateral renal tuberculosis when the typical shadows frequently

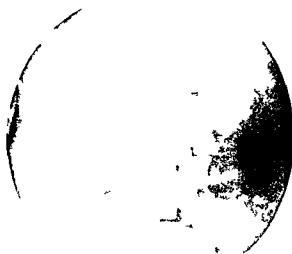
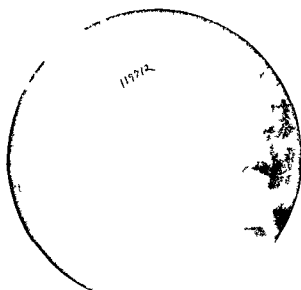
render cystoscopy or further clinical examination unnecessary.

The roentgenographic shadows are caused by the deposit of calcium in the tuberculous area and may assume a variety of forms. To one who has had considerable experience in roentgenographic interpretation such shadows will have characteristics that are usually recognized. They may be differentiated from a stone shadow by (1) the variability in its density as the shadow is irregularly concentrated in different portions ( ) by a shadow of lesser density throughout than that usually observed with stone and (3) by its irregular and indefinite outline. The calcareous area may however simulate the shadow of a renal stone in every particular and it may be quite impossible to differentiate it without further clinical data. The same is true of renal stones that are occasionally seen of such consistency that the shadow will be fully as irregular and hazy in outline as a typical tuberculous shadow. It may be said however that approximately 75 per cent of tuberculous renal shadows may be recognized as such in the roentgenogram.

On resection of the kidney an examination of the areas casting shadows in the roentgenogram will show a considerable variability in the nature of the calcareous deposit. Usually two definite types are recognizable namely actual deposits of lime encrusting the ends of the calyces and crested areas containing a sufficient deposit of calcium to cast a shadow. Tuberculous shadows may be roughly classified under three groups: (1) multiple scattered small areas ( ) single or a few localized areas of one centimeter or more in diameter and (3) large irregular diffuse areas involving either a large portion or the entire kidney.

In the first group the small scattered areas are generally caused by lime deposits. They are occasionally seen singly and appear as elongated irregular faint streaks or as multiple punctate areas scattered over a large portion of the kidney usually in one of





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the pole. Unless the renal area in the roentgenogram is carefully examined such areas may easily be overlooked.

The second group representing single or several isolated areas of concentrated calcareous deposit is the type most easily confused with stone. The shadows are usually of several varieties: (1) a shadow of irregular outline with a consistency denser than that seen with renal stone and varying in size from 1 to 3 or 4 centimeters; (2) a shadow characterized by great irregularity in its consistency and outline, somewhat resembling blighted work; and (3) definite shadows with a density and contour suggestive of stone. The size of the shadow in no way indicates the extent of the tuberculous lesion. A shadow of only 1 centimeter or two in diameter may be present in a tuberculous lesion involving the entire pole or even the complete kidney.

The third group is characterized by large, regular, rounded shadows of variable density in their various portions. As a rule on section the kidney is of a putty-like consistency in the area which causes the shadow. It is however impossible to tell from the appearance of such caseated areas whether or not a shadow will be present in the roentgenogram. In two caseated areas of similar appearance one may

cast a shadow and the other none at all. Occasionally the calcium deposit is so slight that a soft diffuse shadow will be seen only on careful plate reading and it may be easily confused with similar shadows cast by the bowel.

Shadow caused by complete caseation of the kidney are most striking. They may assume the outline of a complete cast of the kidney and are usually irregularly lobulated. The shadow may vary in density in different portions of the kidney, some of which may be so dim as to be scarcely discernible while others may be definitely and strikingly outlined. Occasionally with complete or extensive calcification the calcium deposit may be so slight that the X-ray simulates that of an accentuated normal renal outline and it may be difficult to determine whether or not it is an actual pathologic shadow.

Actual renal stone formation is rare in tuberculous kidney. When it does occur it is generally a phosphatic stone formed in a localized abscess with necrotic and secondary infection. We have observed this in several cases. Stone formation in the opposite kidney in case in which a tuberculous kidney had been removed occurred in but two instances that came under our observation. One patient

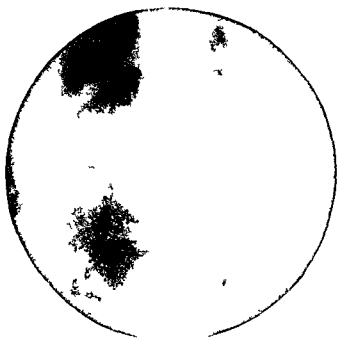


Fig 3 Single large calcified area in the lower pole of the kidney which belongs to Group 2 suggestive of renal stone

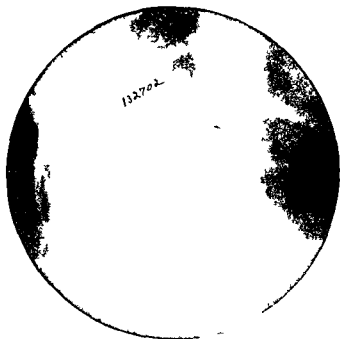


Fig 4 Typical fligree shadow belonging to Group 2

passed a small renal calculus from his remaining kidney two years after the other kidney had been removed for tuberculosis. It may be inferred that primary stone formation is unusual in patients with renal tuberculosis.

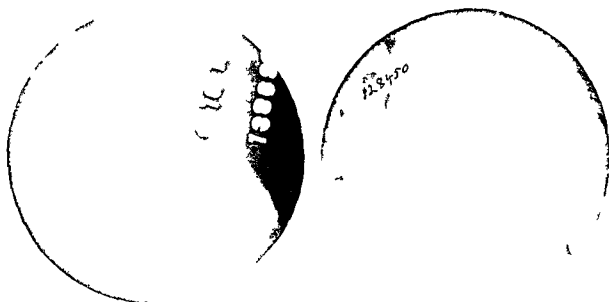
**Extrarenal shadows.** Calcareous deposits of the kidney may be confused with renal stone. They must also be differentiated from various extrarenal shadows which frequently appear in the roentgenogram. The most common cause of confusion is the deposits in glands situated in the perirenal tissues. Calcified tissues situated in the pleura, subdiaphragmatic and retroperitoneal areas are especially likely to cast shadows closely simulating intrarenal calcification. Next to be considered is the possible confusion of shadows caused by substances in the bowel. These may be readily identified however by disappearance or change in position while subsequent roentgenograms are being made. Gall stones may also occasionally cast a shadow which will closely simulate renal tuberculosis.

**Ureteral shadow.** Calcareous deposit may occur with tuberculosis in the ureter although less frequently than in the kidney. When it is present a considerable portion of the ureter usually the lower portion is involved. The shadow may be several centimeters or more

in length and outline the dilated ureter to a greater or less extent. The shadow is caused either by calcareous deposits in the thickened wall of the ureter or by intra-ureteral calcareous deposits. Such deposits are generally accompanied by similar caseation in the kidney. Considerable peri-ureteritis may accompany this calcification of the ureteral wall. The peri-ureteral infiltration together with the thickened ureter will often cause a tumor mass which can easily be palpated on rectal or vaginal examination. Often calcified glands in the bony pelvis will cast shadows suggestive of either stone or tuberculous deposit in the lower ureter. They however usually occur with no clinical evidence of tuberculosis in the urinary tract or other portions of the body, and are therefore of no diagnostic significance.

**Calcareous deposits in the prostate gland.** Occasionally calcium deposits secondary to tuberculosis in the prostate gland cause roentgenographic shadows suggestive of prostatic stone. Although the clinical findings should differentiate the two conditions a chronic healed tuberculous infection may be overlooked.

**Renal outline.** Interpretation of the outline of the kidney itself in the roentgenogram is



The following is a list of the factors which interfere seriously with accurate interpretation of the renal outline. Occasionally, as Casper has stated, the outline of a greatly hypertrophied kidney on the opposite side of a tuberculous shadow may be of value in indicating hypertrophy subsequent to destruction of the diseased kidney. However, one would be loath to remove a definitely tuberculous kidney without further proof to demonstrate that the hypertrophied kidney is otherwise normal.

not of much practical value. Some observers have claimed that irregularity of outline of a tuberculous kidney may be demonstrated in the unaided roentgenogram. However, the possibilities of error are so great that these data are not to be relied on. It is well known that bowel contents, the outline of surrounding organs, change in position of the kidney, etc., are factors which interfere seriously with accurate interpretation of the renal outline. Occasionally, as Casper has stated, the outline of a greatly hypertrophied kidney on the opposite side of a tuberculous shadow may be of value in indicating hypertrophy subsequent to destruction of the diseased kidney. However, one would be loath to remove a definitely tuberculous kidney without further proof to demonstrate that the hypertrophied kidney is otherwise normal.

**Bilateral involvement.** Roentgenography evidence of renal tuberculosis may lead to evidence of bilateral involvement or that the patient is otherwise inoperable. With shadows of definite tuberculous calcification present in both kidneys, as cystoscopic and further clinical investigation is usually unnecessary. It must be remembered, however, that bilateral renal tuberculosis may exist even though a tuberculous

shadow may be found only in one kidney area. This is particularly true with a chronic tuberculous infection in one kidney and a recent involvement of the other. If the bladder is in such a state that it is impossible to make a satisfactory cystoscopic examination, a shadow of calcification in one kidney area might be of considerable diagnostic value. This is illustrated in conditions as follows:

(1) when the healthy kidney has been catheterized and it is impossible to find or catheterize the other side; (2) when neither meatus is found but the patient's general condition and the renal functional tests indicate the existence of one healthy kidney; and (3) when evidence of disease is found in the kidney that is catheterized and there is a shadow of calcification in the kidney which cannot be catheterized.

**Pycnography.** A common source of error in diagnosis is the confusion of shadow caused by renal stone and by tuberculosis. The clinical findings may be identical. At operation, instead of finding the expected stone and performing a lithotomy, the surgeon will be called on to do a nephrectomy for tuberculosis. Although the cystoscopic and laboratory findings will usually identify the tuberculous shadow occasionally they too will fail

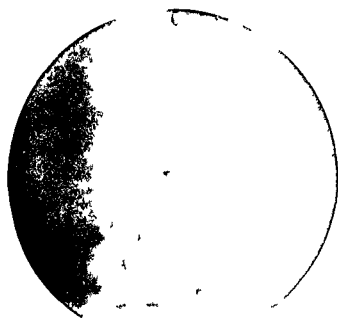


Fig. 7. Outline of a completely calcified kidney.

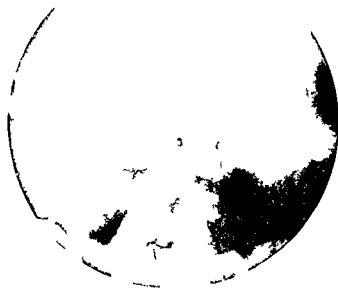


Fig. 8. Calcification in both kidneys: condition of left and in b lateral renal tuberculous.

In the identification of such shadows as well as of renal infection of a doubtful nature, pyelography will frequently afford valuable information by demonstrating the pathological changes in the pelvic and ureteral outline peculiar to tuberculosis.

The changes in the pelvic outline regarded as characteristic of tuberculosis consist of one or more of the following: (1) irregular inflammatory dilatation of the pelvis; (2) irregular cortical necrosis; and (3) stricture in the ureter.

Inflammatory dilatation of the pelvis is the result of tuberculosis in its early stage and is largely confined to the calyces. The dilatation is differentiated from ordinary inflammatory dilatation by the greater irregularity in outline of the calyces and by the variability of degree of dilatation among the different calyces. A peculiarity often noted is marked dilatation at the uretero-pelvic juncture.

When the process is advanced so as to cause necrosis of the renal parenchyma adjacent to the calyces, the pelvic outline becomes irregular and indistinct to a variable degree. When the necrotic areas are confined to one or two calyces the outline of the latter will have a moth-eaten appearance at the apices and the pyelographic medium is visible

as a hazy shadow extending into the parenchyma. When the necrotic process is advanced it may either assume irregular forms scattered through the parenchyma or it may coalesce to form a large irregular sac.

Occasionally the outline of the necrotic area is apparently detached from the pelvis



Fig. 9. Calyx filled with the lower portion of a tuberculous kidney.

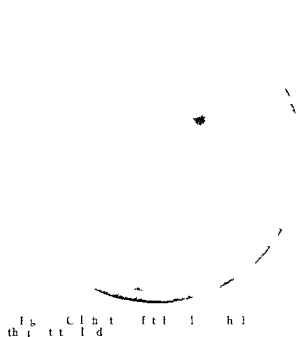


Fig. 1. Pelvic roentgenogram showing dilated internal bladder sphincter and posterior urethra.



Fig. 2. Pelvic roentgenogram showing dilated internal bladder sphincter and posterior urethra.

or connected with it by a narrow isthmus. When the area of necrosis is confined largely to the cortex and is not directly communicating with the pelvis the pelvic outline may occasionally become contracted in a manner resembling certain forms of pyelonephritis.

As a result of the infective process in the kidney inflammatory dilatation of the ureter will follow and may be demonstrated in the ureterogram. Should the ureteral mucosa become ulcerated however and a stricture ensue mechanical dilatation may also be present. Ureteral dilatation resulting from tuberculous stricture in the ureter may be confused with that resulting from a benign stricture or obscure lithiasis. If the clinical and cystoscopic findings are insufficient with which to identify the lesion pyelography will usually demonstrate abnormality in the pelvic outline that is suggestive of tuberculosis.

The cystogram may also occasionally be of diagnostic value. This is particularly true when it is impossible to find either one or both meatus. The bladder outline will be variably contracted and usually more in one half of the bladder. The demonstration of a dilated ureter by making a cystogram with the patient in the Trendelenburg position is suggestive of renal involvement on that side. Demonstration

of a widely dilated internal bladder sphincter and posterior urethra in the presence of a severe cystitis is also suggestive of tuberculosis.

#### CONCLUSIONS

1. The value of roentgenographic diagnosis of renal tuberculosis does not appear to be fully appreciated.

Routine roentgenography in every case in which there is evidence of infection in the urinary tract is advisable.

2. Shadows may be found in approximately 50 per cent of patients with renal tuberculosis. Such shadows may require the aid of cystoscopic data in their interpretation.

3. Positive evidence of tuberculosis may be obtained by this method when all other clinical data fail and when cystoscopic examination is impossible.

4. Shadows due to renal tuberculosis may be arranged into three definite groups.

5. Caserated areas in the ureter and prostate may also be outlined.

6. Pyelography is occasionally valuable (1) in the identification of renal infections of doubtful nature and (2) in the identification of doubtful shadows in the renal area.

7. The cystogram may also give data of value (Figs. 1-11).

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## ACUTE INTESTINAL OBSTRUCTION FOLLOWING APPENDECTOMY

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DESPITE the development of greater proficiency postoperative intestinal obstruction occurs sufficiently often to warrant occasional discussion. Acute intestinal obstruction secondary to appendectomy is one phase of the general topic demanding critical attention as to the manner of causation and production. It is a demonstration that the last word has not been said concerning appendicitis despite the voluminous literature existing on the subject a fact evident to those engaged in active surgical service where the mortality of acute appendicitis is still a matter of serious concern.

The special point in the discussion is the prevention of the condition. An analysis of the methods of treatment merely detailing one aspect of the general subject of intestinal obstruction would not permit so practical treatment of the question as an investigation of the manner of production of the obstruction. It will not be necessary to analyze the personal cases herein reported regarding the special lesions produced in each instance for the specific causes can be obtained from a general reading of the literature. Certain distinct mechanisms however come to mind at once. I refer particularly to the role played by the omentum and that taken by adhesions. The omentum owing to its migratory nature in abdominal inflammation may contract a firm adhesion to an organ especially the tube or uterus producing as a result a

sling or hammock over or beneath which an intestinal loop may be constricted. If the omentum is lax or loose intestinal occlusion does not occur. On the other hand if the omentum from any cause becomes taut for example from elevation of the transverse colon or from a twist or torsion in the omentum itself it acts as a tightly drawn string playing on the face of the intestinal loop. When the obstruction acts intermittently there results secondary to strangulation transudation into the peritoneal cavity. An omental band from anatomical reasons is more likely to obstruct the small than the large intestine. A history of a previous abdominal operation adds a confusing element. Pelvic operations performed at a period when peritonization of pedicles and raw surfaces was not generally practiced furnish numerous instances of postoperative intestinal obstruction due to bands adhesions and false ligaments.

The artificial and experimental production of adhesions lends itself readily to a study of their prevention. A review of the histology of the peritoneum however, fails to bring out any vital points. There exists no doubt a distinctive peculiarity of the mesothelial cell which favors its proliferation. Also the lymphatic current of the peritoneum of which so little is known may be important. The tendency of the peritoneum to agglutinate appears as a reaction to irritation.

physical or chemical. It is a primary and characteristic manifestation of a cell and in this instance is an indication of a defensive mechanism. The mere presence of the operator's fingers may occasionally be sufficient to produce adhesions. On the other hand a prolonged operation with considerable handling and manipulation of the intestine may occasion no essential change in the peritoneum. The extent of the infection appears negligible. A gangrenous appendicitis associated with diffuse peritonitis may lead to no discernible sequelæ whereas an interval appendectomy with a minimum amount of peritoneal contact may rapidly produce proliferative changes and band formation.

There are individuals in whom a tremendous degree of intestinal matting may exist without the slightest personal discomfort or objective indication. In a young married woman who came under my observation at St. Francis Hospital I opened the abdomen with the intention of correcting a retroverted uterus, the main and sole symptoms being backache. At operation there was found an intestinal matting and agglutination almost indescribable in its complexity. In a word it is evident there exist compensatory mechanisms which overcome the stenosing effects of these knots and twists. Doubtless this is associated with the degree and vigor of the peristalsis but the physiology of the intestinal movements is still in many respects a closed chapter.

In the past the subject of postoperative obstruction has been largely discussed from the point of view of the effect of drainage. There is no question regarding the objectionable reaction of abdominal drainage. It is manifest that a foreign body left in the peritoneal cavity must inevitably act as an irritant. Not only its actual presence but the respiratory movement of the abdominal wall and the peristaltic activity of the intestine increase the deleterious consequences of the drain. This point having been unduly emphasized has perhaps led surgeons to show a tendency to discard drainage or at least to reduce it to a minimum. A few years ago this practice became almost perilous in its consequences when the custom to close the

incision in acute gangrenous and acute suppurative appendicitis with small amounts of exudate became general. This was but a natural reaction from the principle of so-called sequestration when large quantities of gauze were inserted surrounding the field of operation. The gauze was permitted to remain letting the house surgeon assume the responsibility and incidentally the censure for its removal. This method of drainage aptly called *taxidermy* by a facile writer has been discarded. The small cigarette drain or split rubber tube is now the usual method of drainage. It is easily improvised and apparently causes a minimum amount of peritoneal reaction. One cannot leave this phase of the question however without speaking a word in favor of gauze. There are distinctive types of cases in which gauze drainage is indispensable. I refer specifically to those in which the ligation of the meso-appendix is insecure or uncertain or in which hemorrhage has taken place during the delivery of the appendix. Moreover gauze drainage is imperatively needed in the cases associated with impending gangrene or perforation of the cecum. Through its capacity to stimulate adhesions gauze tends to localize the infection.

The method employed of treatment of the stump — simple ligation or inversion — seems to be immaterial. One should attain a degree of asepsis extreme as possible. Any extraneous leakage favors the development of plastic adhesive peritonitis. When alcohol and carbolic acid are used to sterilize the stump care is needed to prevent accidental contact of the solutions with the intestine. Naturally in a case demanding drainage the element of peritoneal irritation and reaction is uncontrollable. Here the sequelæ of band formation intestinal matting and kinking are inevitable as no method exists which entirely obviates these objectionable end results.

A possible cause of adhesion formation is suggested in the widespread use of iodine in the preliminary sterilization of the field of operation. It is known in fact has been experimentally proved that iodine is a peritoneal irritant. The intestine particularly the

small intestine should not come in contact with the skin. I use dry laparotomy pads to wall off the appendix. They are more apt to maintain their position when spread out flat and do not crumple to form a ball like mass. They preserve a dry field and absorb the pus and blood with greater ease and rapidity. There is experimental evidence which tends to demonstrate that laparotomy pads soaked in hot solution are less liable to create intestinal adhesion but as the formation of intestinal adhesions is not clearly understood and subject to many interpretations this theoretical objection may be overlooked.

The symptoms of acute intestinal obstruction are so well known that it is needless to repeat them. Of course the type of obstruction considered here is the purely mechanical or dynamic type usually due to a band or kink. The most common form of postoperative obstruction is concomitant with the extension of the infection to the peritoneum. This produces the most intractable type of intestinal paralysis. The underlying pathology is evident. The wall of the intestine is saturated with the toxins and products of the bacteria. As a result the local neuromuscular mechanisms are poisoned and paralyzed. The administration of powerful cathartics under these circumstances is not only useless but stupid. There is a rare type of obstruction due to a functional paresis or perhaps inhibition of the intestinal musculature. This type responds readily to liberal doses of pituitrin. Eserin salicylate widely heralded at one time as a panacea is an uncertain drug and moreover known to depress the circulation. I have seen several instances when death promptly followed its use. It has been stated that one of the most important signs of intestinal obstruction is the rise in the leucocyte count. In order to estimate properly the value of this sign it would be necessary to have the blood examination before and a daily count following operation. In a busy hospital this procedure is not feasible. Moreover as the blood count is modified by so many factors incidental to an operation as hemorrhage and infection its significance is susceptible to various interpretations. A bimanual examination aids in the diagnosis.

It occasionally happens that an incarcerated or strangulated loop may fall or even lie in the pelvis. Bimanual examination then discloses a tense cystic swelling behind the posterior fornix.

Intestinal obstruction is rarely so sudden in onset as to mimic internal hemorrhage. Yet an acute strangulation of an intestinal loop may cause shock and collapse so severe as to suggest the diagnosis of internal hemorrhage. In a woman who had been operated on by a colleague for chronic appendicitis and salpingitis strangulation was so sudden that severe shock took place at once and collapse rapidly supervened. The traditional symptoms of internal hemorrhage were clearly simulated. Yet at operation I found no evidence of hemorrhage. A loop of ileum was strangulated beneath a pelvic peritoneal band.

Acute obstruction of the small intestine particularly when the obstructing force acts intermittently is insidious in its effects. I have found it hard to determine the intrinsic gravity and seriousness of the condition. The error lies unquestionably in underestimation. One is apt not to intervene until the intestine becomes the seat of infarcts. The conclusion is unescapable that immediate operation is indicated. Caution must be exercised in calling a case subacute in character.

When the obstruction takes place during convalescence the question arises whether one should enter the abdomen through the original incision. If this incision is still draining or though primarily closed has reopened from infection the new incision should be placed elsewhere otherwise infection may be transmitted to the central abdomen and peritonitis rapidly engendered. Ample room is needed to deal satisfactorily with the lesion. Naturally if a short circuiting operation is chosen generous exposure is requisite. If a concomitant pelvic lesion is suspected the lower extremity of the right rectus incision is curved downward and inward forming a modified hockey stick incision. This extension permits a larger exposure of the pelvic organs and grants sufficient freedom for the proper operative treatment of the tubes. If the distention is severe caution is exercised in divid-



ing the peritoneum for the intestine may be firmly pressed against the anterior abdominal wall. One should endeavor to avoid evisceration as the prolapse of the distended coils increases the likelihood of shock, entails excessive manipulation and favors peritoneal infection. Evisceration is distinctly objectionable. It is a positive excitant to shock in point of fact, nothing produces shock so quickly in dogs as evidenced by physiologists in experimental animal work. In order to lessen the likelihood of the occurrence of shock, it is the custom to cover the protruded intestinal coils with towels of hot saline solution. This is done to lessen the loss of heat. Though this step is necessary under these circumstances, it introduces the principle of wet operating which is so productive of peritonitis. Moreover there is not only the danger of losing or enclosing towel and sponges but one finds that constant pressure from an assistant's hands is needed to prevent the intestine from sliding from the abdominal wall. A short primary incision decreases the possibility of evisceration but a generous use of laparotomy pads rapidly introduced is the best method to prevent the protrusion of the intestines.

The large intestine is palpated in a systematic manner. Beginning with the cæcum the examining hand passes in sequence to the flexures and ends at the rectum. This is a crucial step. The large intestine is not easily mobilized and can only with difficulty be brought to the margin of the incision for inspection. It is essential however to determine definitely the state of the sigmoid and the rectum. The technique thus outlined is followed when the small intestine is distended for this inevitably proves that the obstruction is at a lower level. When a loop of small intestine is seen collapsed and ribbon-like in appearance the operator should grasp and follow it to the site of obstruction which must inevitably be at a higher level. It is difficult at times to know whether one is passing up or down the small intestine. This can occasionally be determined by the direction and inclination of the mesentery for the mesentery of the small intestine it will be recalled passes in general from above down

ward and to the right across the vertebral column. If the surface of the mesentery can be seen one can easily determine whether a twist or a torsion is present. A reddening of the peritoneum is most intense at the site of obstruction.

In the simpler cases the division of a band or the releasing of a kink may be curative. On the other hand these minor procedures may not be sufficient to relieve the obstruction or though the obstruction is relieved distention persists. Following the surgical relief of an obstruction of the small intestine it is not an uncommon experience for the patient to succumb with symptoms indicative of severe toxæmia. Despite the relief of obstruction the complete technical success and the evident immediate improvement a complete change in the patient's condition may take place within a few hours. The exact mechanism underlying this form of postoperative death is not accurately understood. The usual explanation is that following the relief of the obstruction the highly toxic material dammed behind the obstruction passes quickly into the unobstructed segment where its rapid absorption causes death. It is still a mooted question whether the cause of death is chemical or bacterial.

It is probable that active processes in the wall of the intestine may play a part in the mechanism. In operations for acute obstruction involving the small intestine it is a matter of general observation to note that the segment oral to the point of obstruction is usually markedly distended and the color greatly changed. The color as a rule is a cherry red or perhaps dark brown or black according to the degree and state of the arterial or venous obstruction. These appearances are in marked contrast to the size and color of the aboral intestine. This segment is generally collapsed resembling a flat tape, it is pale pink in color and void of contents. Keeping these two diverse conditions in mind it is evident that when the obstruction is relieved the contents of the oral segment pass rapidly into the collapsed bowel the absorbing capacity of which must be augmented. While the relief of the obstruction is an advantage from the mechanical viewpoint it

is patent that a possible injury may result in that the toxic material is permitted to flow to a fresh intestinal surface where absorption is rapid and fatal. Thorough post mortem studies are needed to explain these cases. At operation one is struck with the numerous areas of dark discoloration on the wall of the distended intestine. It is possible that these represent infarcts of greater or less extent caused by an obstruction of the mesenteric arteries and veins. From the macroscopic examination of the intestine at operation it is difficult owing to lack of time to decide whether this infarct is arterial or venous. No doubt exists that these lesions must be considered as possible factors in the sudden death of the patient.

The occurrence of sudden death is indeed so striking that in order to obviate this result surgeons have advised the incision and drainage of the distended loop before the relief of constriction. From a practical view point the procedure is not always easy to accomplish. There constantly exists the danger of accidental contamination of the peritoneum during the process of emptying a coil. A short circuiting operation might conceivably eliminate the danger of rapid absorption provided the anastomosis was made to some part of the colon for this part of the intestine appears to possess inherent means of defense against bacterial and toxic absorption a function no doubt acquired through heredity or explained by the fact that the toxic material is more quickly evacuated. It is in this connection that the operation of ileocolostomy is valuable.

The terminal ileum if the site of adhesions is apt to present a characteristic appearance. The last few feet of the intestine are folded in a more or less continuous pleated manner the individual arms of the plect being comparatively short. It is manifest that the matted condition should remain untouched and no attempt be made to disentangle the tortuous loops. An elaborate dissection would inevitably lacerate the intestine or injure a mesenteric vessel. Any operative manipulation would expose the patient to the dangers of peritonitis and hemorrhage. If these accidents were of moment a resection would be indi-

cated. Moreover a dissection of the adhesion would prove valueless for within a few hours the process of agglutination would recur resulting perhaps in a form of adhesion more complicated than the original state. No attempt therefore, should be made to dissect extensive adhesions of the terminal ileum. Another procedure must be employed. In the operation of ileotranscolostomy there exists an ideal technical procedure for obstruction of the lower ileum, due to a matted, twisted or adherent ileum. The prevention of toxic absorption and the necessity of avoiding an extensive dissection of the terminal ileum present the two main indications for a short circuiting operation.

Ileotranscolostomy signifies the union of the terminal ileum to the beginning of the transverse colon. The indication for this operation is furnished by an insuperable obstruction located in the terminal ileum, the cecum or the ascending colon. It obviates the performance of an enterostomy or a cecal fistula. An enterostomy though highly recommended by eminent surgeons makes no general appeal. It is admittedly a makeshift. I refer specifically to the disadvantages accruing from the irritation of the skin and the loss of nutritive fluids in a patient already weakened and debilitated. The main objection consists in the uncertain technique. To secure the intestine to the margin of the peritoneum is merely to invite the development of peritonitis. To draw the loop outside the abdomen means a secondary operation possibly a resection. To find and verify the lower ileum requires considerable handling. In my experience opening of the bowel has caused collapse of but a few feet of intestine. Personally I have discarded this practice for its so called advantages appear purely chimerical. The operation can be easily performed through a right rectus incision. As a rule the ileum at a point about six inches from the ileocecal valve can be apposed without undue tension or traction to the first one third of the transverse colon. It will be recalled, in this connection that the transverse colon is exceedingly mobile and that the weight of the attached omentum acts as a downward pulling force. The ileum at two points is

united with linen traction sutures to a longitudinal band of the transverse colon. It is often difficult during the performance of an operation for intestinal obstruction from distention of the intestine accurately to determine the location of the small intestine selected to be opened. Naturally if the band selected is the jejunum or upper part of the ileum there will exist grave danger to the patient from malnutrition and exhaustion caused by the loss to the body of nutritive fluids.

In order to prevent the escape of the intestinal contents occlusion is obtained by the use of gauze tapes. Though intestinal holding clamps with blades ensheathed in rubber tubing are widely used for this purpose increasing experience proves that they are cumbersome and inconvenient particularly during the necessary turning and manipulation of the intestine. Moreover they have a tendency to slip and are difficult to apply with the proper degree of pressure. On the other hand gauze tapes are usually available but it not can be quickly improvised. They are easily applied. With a blunt nose hemostat the mesentery is pierced close to the intestinal border the jaws of the clamp are partially opened and a thin flat tape passed through the hole. The tape is tied with a simple bow knot which permits its ready release.

The anastomosis is of the antiperistaltic type. In order to make an isoperistaltic anastomosis it is necessary to turn the ileum in a direction the reverse of its normal course. This step consequently would occasion a twist in the mesentery and possibly cause an interference of the circulation of the mesenteric vessels. Moreover there is a probability that so extreme a torsion would favor the occurrence of volvulus. The technique of the suture is the same as that of a lateral anastomosis. The method suggested by William J. Mayo for posterior gastrojejunostomy is perhaps the best. The omentum fortunately favorably placed may be utilized in the protection of the suture line. By disposing it in front of the suture line at the completion of the anastomosis considerable security is granted.

In a young man with acute intestinal obstruction caused by an occluding carcinoma of the cecum I performed an anastomosis with immediate relief between the ileum and the transverse colon. Several weeks following intermittent attacks of abdominal pain hastened the secondary operation for the removal of the growth which operation I had hoped in order to improve nutrition to postpone for a longer period. At this secondary operation a large mass of the small intestine was found herniated to the right beneath the loop passing to the colon for the anastomosis. The reduction was simple and did not interfere with the subsequent resection of the cecum and ascending colon. The accident demonstrated however the need to obliterate any potential opening in the peritoneum in the performance of a lateral anastomosis (short circuiting) operation. It will be recalled that Arbuthnot Lane experienced a similar difficulty in his operation of ileosigmoidostomy which to overcome the small intestine is entirely eviscerated in order to suture its mesentery to that of the descending colon. A remedy consists in approximating and suturing the ascending colon or hepatic flexure to the anastomosing loop. In case of a subsequent resection of the cecum and the ascending colon the outer end of the transverse mesocolon may be directly united to the divided mesentery of the ileum.

Appended are the author's personal case. Case 5 is inserted because of its close relationship from a technical view point.

CASE. Acute intestinal obstruction caused by a band strangulating the ileum. Appendectomy 10 years previous. J. P. age 6 admitted with the diagnosis of acute intestinal obstruction December 4, 1913 discharged January 1, 1914. Ten years ago the appendix was removed at another hospital. The present illness began three days ago. There is severe abdominal pain situated mainly in the right lower quadrant. There is vomiting and obstipation. The abdomen is slightly distended. There is a soft mass in the right iliac fossa. The scar of a previous right rectumectomy could be seen. Immediate operation. Right rectum incision disclosed intestinal obstruction from the lower ileum. The distal end of the ileum is simple in color thickened and distended. The mesentery was gangrenous and perforated several places. A band of mesentery long and 3 inches wide passed between the cecum and the parietal peritoneum.

toneum The ileum was strangulated by this band The band was ligated and divided Hot towels applied to the ileum quickly restored the circulation The abdominal wall was closed in layers Primary union Recovery

CASE 2 Acute intestinal obstruction of the ileum following appendectomy Ileocolostomy Recovery M H female age 19 admitted August 18 1914 Discharged September 6 1914 Eleven months previous to admission an appendectomy was performed for acute appendicitis The ligation method with cauterization of the stump with phenol and alcohol was used The patient remained in the hospital 16 days Primary union Discharged cured Since this operation she has been perfectly well until about two weeks before admission when she experienced severe and constant pain in the abdomen One week before admission constipation was marked cathartics and enemas failing to give relief She vomited several times each day and on the day of admission fecal vomiting was noted On examination symptoms of grave toxæmia were detected The pulse was exceedingly rapid and the abdomen distended No visible peristalsis no mass felt Operation on August 18 1914 Right rectus incision The small intestine was found greatly distended Many adhesions existed around the terminal ileum An attempt was made to separate these adhesions but was abandoned because of the technical difficulty A free loop of the ileum immediately above the area of the adhesions was anastomosed to the transverse colon The abdomen was closed with through and through sutures The postoperative course was smooth until on August 4 sixteen days following operation when nausea and constant vomiting began The following day the abdomen became distended and the bowels could not be moved On the 26th the vomiting was constant the abdomen distended and the pain severe The patient improved slightly the following two days An X ray showed an obstruction of the small intestine in the afferent loop A secondary operation was performed August 9 1914 The anastomosis was found in an excellent condition A portion of the transverse colon was adherent to the small intestine close to the anastomosis The adhesion was divided and the obstruction relieved Wound resutured Primary union Discharged cured

CASE 3 Acute appendicitis with spreading peritonitis Appendectomy Acute intestinal obstruction Enterostomy Death S T age 6 admitted November 6 1914 died November 20 1914 The present illness began with severe pain in the abdomen two days previous to admission She has had two former attacks one six months ago and one two months ago On examination there were found the typical symptoms of acute appendicitis A mass was felt in the right lower quadrant An intermuscular incision The appendix was about three inches long gangrenous and perforated at the tip There was considerable free pus

with a marked fecal odor The patient did not do so well The pulse increased in rapidity became small and the patient vomited constantly On November 8 the distention was great the obstipation complete and the vomiting profuse Immediate operation Median incision A kink was found in the ileum about six inches from the cæcum The kink was relieved by dividing numerous adhesions As complete stasis of the upper bowel existed an enterostomy was done The patient died twenty four hours following operation

CASE 4 Acute appendicitis with abscess Drainage operation Acute intestinal obstruction from two constricting bands Ileotranscolostomy Recovery J B admitted November 20 1916 discharged February 1917 Has had several previous attacks The patient was well up to nine days prior to admission The pain in the abdomen had become generalized radiating to the right iliac fossa The patient has vomited three times No obstipation On examination there was felt in the right iliac fossa a dense globular mass Dullness could be elicited over the same area There was considerable pain on palpation Pelvic examination was negative Right rectus incision An appendicular cavity containing foul pus was entered The appendix was not sought as it formed part of the wall of the abscess The cavity was packed with plain gauze and the abdominal incision partially closed in layers The patient did well for four days On the fifth the abdomen showed marked distention and hiccoughs appeared The symptoms continued several days and were finally relieved by colonic irrigation The wound edge however was widely opened Twenty days following operation distention and pain and visible peristalsis were noted It was evident that symptoms of obstruction were present Operation on December 15 1916 Median incision Small intestine greatly distended especially the jejunum and upper portion of ileum A band 4 inch thick was ligated and divided A second band was found and cut The lower portion of the ileum was collapsed In the right iliac fossa there were dense adhesions between the ileum and the cæcum A distended loop of small intestine was isolated and anastomosed to the transverse colon The abdominal wall was closed An intravenous injection was given on the table The patient made a slow but a constant recovery Discharged cured February 1917

CASE 5 Volvulus of cecum with Jackson's membrane Ileotranscolostomy Later resection of the cæcum ascending colon and ileum Age 31 admitted to hospital August 7 1913 Family and personal history negative The present illness began with severe cutting pain in the right side of the abdomen and vomiting On admission to the hospital a mass could be felt in the right lower quadrant rigidity of the recti and dullness on percussion in the right iliac fossa Temperature 99.4 Pulse 80 Ether narcosis Exploratory laparotomy A large cystic mass was felt occupying the right iliac region

and the upper part of the pelvis. At first it appeared like a ovarian cyst with a twisted pedicle. On closer examination on the cæcum the ascending colon and the terminal ileum were found intimately bound together and rotated in a longitudinal direction in other words a partial volvulus. On closer examination a membrane was found which passed down over the cæcum covering and enclosing the appendix. This membrane also passed down over the terminal ileum. An attempt was made to free the ileum by dissecting the adhesions but it was given up for fear of wounding the small intestine. A short cutting operation was done. The ileum was divided the omentum closed with four layers of sutures and a lateral anastomosis made with the beginning of the transverse colon. The abdominal incision was closed and lightly sutured to the lower end of the incision. No intestinal dragging was necessary in order to bring the ileum to the colon. Uneventful recovery took place. On August 2 the ascending colon the cæcum and terminal ileum were removed in one operation. Complete recovery.

CASE 6. This patient had been ill thirty six hours before admission with the classical symptoms of acute appendicitis. Operation August 4, 1918. A short right colectomy incision revealed a moderately inflamed appendix. It was removed by the ligation method and cauterization of the stump with phenol and alcohol. The post-operative course was smooth until the fourth day when severe abdominal pain occurred. The pain rapidly increased in intensity and vomiting took place. Enemas were without result. In the presence of severe abdominal pain vomiting did complete obstipation on an immediate operation was performed. A loop of ileum was found adherent to the cæcum. The adhesions were divided and the intestine liberated. Uneventful recovery.

CASE 7. A young married woman had had an appendectomy done the year before. A right colectomy had been done. The method of treatment of the stump was not ascertained. The patient complained of severe abdominal pain. There seemed to be no element of hysteria present but the attending neurologist Dr. Joseph B. reported that he believed the pain to be of organic origin. Operation February 1918 revealed a loop of the ileum adherent to the parietal peritoneum. Uneventful recovery.

CASE 8. Mr. F. age 35 admitted to St. Francis Hospital December 7, 1918. He was operated on seven years ago in Bellevue Hospital for acute suppurative appendicitis. Drainage was evidently employed for the appendix scar was broad. For the past six months he has suffered from gastric symptoms. Complaints of pain after eating. No history of the vomiting of blood. Present illness. Today he was taken suddenly ill with severe and aching abdominal pain and vomiting. The pain is referred to the central part of the abdomen. The patient appears pale and weak. The condition looks as if it were perforation of a duodenal ulcer or a secondary

obstruction due to the previous operation. The abdomen is rigid. Immediate operation. Right colectomy incision. A small amount of clear fluid escaped from the peritoneal cavity. The transverse colon and the cæcum were contracted and empty. A loop of the small intestine brought up was empty. A second loop was greatly distended and contained fluid. The surface of the intestine presented numerous areas of dark discoloration. Diagnosis. Acute intestinal obstruction. In the region of the previous operation a thin band was found which passed from the parietal peritoneum in the region of the scar upward and inward to the convex border of an intestinal loop. This band compressed and completely obstructed a second loop of small intestine. The band was divided and excised. The abdomen was closed without drainage. Primary union. Discharged cured.

CASE 9. A young woman age 30 single admitted to Fordham Hospital March 18, 1919. An appendectomy had been performed May 1918. No drainage employed at that time. Since the operation she has suffered from more or less abdominal pain and constipation. March 17 she was taken suddenly ill with severe abdominal pain. Located in the right lower quadrant. She had been constipated for two days previous and had vomited several times during the day. On admission the patient presented a right rectus incision on about three inches long. The abdomen was distended and there was more or less rigidity particularly in the lower half of the right rectus. A point of extreme tenderness was situated immediately over the scar. Temperature normal. Diagnosis. Acute intestinal obstruction. Immediate operation. Ether narcosis. Right rectus incision four inches long one inch internal to the old scar. Upon opening the abdomen clear fluid escaped in a large amount. A loop of small intestine projected itself at once into the wound. It was distended and filled with gas and fluid. At the same time a second loop of small intestine completely collapsed appeared in the lower angle of the incision. It was evident by the marked difference in the appearance of the two loops of intestine that a complete obstruction existed. Upon pulling gently on the collapsed intestine the obstruction was reached. This was caused by a loop of the small intestine being firmly adherent to the parietal peritoneum immediately behind the old incision. The point of adhesion was about seven inches long and attached to the convex border of the intestine in direct correspondence to the lining of the intestine. Separation of the adhesion to slightly the peritoneal coat of the bowel. This laceration was repaired with two layers of interrupted linen. Further examination revealed a thickened band passing from the cæcum to the parietal peritoneum. This band was at least three inches long and appeared to be an extension of an appendix epiploica. Ligation and excision of the band. Closure of the abdomen without drainage. Complete recovery and discharge.





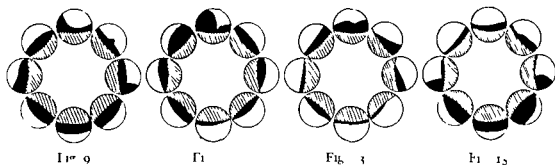


Fig. 9

Fig. 11

Fig. 13

Fig. 15

Fig. 9 Case 1 Bilateral internal sphincter. Middle portion definitely lateral. Both lateral portions definitely lateral. The lateral portions are moderately dilated.

Fig. 11 Case 6 Marked dilatation of lateral lobes. The left lateral lobe moderately dilated. The right lateral lobe moderately dilated. The middle portion is moderately dilated.

Fig. 13 Case 3 Moderate enlargement anteriorly. The middle portion is definitely hypertrophied.

Fig. 15 Case 5 Definite middle lobe hypertrophy. The lateral lobes are moderately dilated.



Fig. 10



Fig. 12



Fig. 14



Fig. 16

Fig. 10 Case 1 roentgenogram No. 605. Cystogram taken four weeks after operation shows the bladder shadow with margins slightly irregular. In the region of the prostatic orifice the shadow is normal and shows no dilatation of the internal sphincter. Residual urine 0.5 cubic centimeters.

Fig. 12 Case 6 roentgenogram No. 588. Cystogram taken four months after operation. The bladder outline is somewhat larger than normal and pyramidal in shape. The vesical orifice is regular and shows no dilatation of the internal sphincter. Residual urine 0.5 cubic centimeters.

Fig. 14 Case 7 roentgenogram No. 498. Cystogram taken four months after operation. The bladder shadow is oval in outline with lateral margins somewhat irregular. The vesical orifice is normal and shows no dilatation of the internal sphincter. Residual urine 0.5 cubic centimeters.

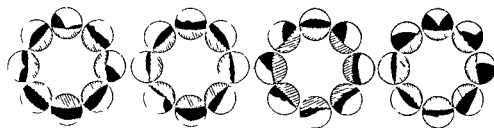
Fig. 16 Case 8 roentgenogram No. 515. Cystogram taken six months after operation. The bladder outline is somewhat oval with margin regular. The vesical orifice is normal and shows no dilatation of the internal sphincter. Residual urine 0.5 cubic centimeters. Bladder capacity 400 cubic centimeters.

the internal sphincter itself unquestionably exerts a very definite supporting action to the function of the vesical sphincter (13). Not every case of suprapubic prostatectomy has a permanently dilated vesical sphincter as was shown by Hyman. We know this must be so also from an occasional complete occlusion of the internal vesical orifice following suprapubic enucleation as has been reported by Gordon (14), Denslow (15) and others and as has been once observed by the writer. In this complication the mucous membrane in its growth bridges over the internal orifice and completely occludes it which occurrence is hardly possible with a permanently dilated vesical sphincter. The action of the external

sphincter, a purely voluntary muscle and directly under the control of the will, can hardly be accredited with the power of remaining tonically contracted for a period long enough to give normal urinary continence. The method of removing the prostate through the perineum by reason of the approach through incisions in the posterior lobe and often times its successful enucleation without rupturing the bladder mucosa at all seemed to offer possibilities for observations on the vesical outlet under conditions quite different than after suprapubic prostatectomy.

For the purpose of this study 25 cases were obtained from the clinic of the James Buchanan Brady Urological Institute. The recent cases





Fig

I

I g

Fig 3

I g C q M th d d l l l l l t i h y  
 th m d t l k m t f th h t l l l l t  
 l l l f t l t l l l l m t  
 F g q C M k d m d l l b l v t j h  
 th l t k l t l l g m t t th l t l l b

I k C S h t l t t d h t l t r a l  
 l b h y p c t j h y f h m l l p o t l g h t l y l t l  
 l t h l f t l t l l l y m l t l y l l  
 I k C F l k m t f t h l t l l t s  
 th l m l l l h y t t j h



Fig 2

Fig

Fig

Fig 4

I g 8 C s e o t g g m N 5 C y t m  
 t k n g h t m th f t p t Th b l d d h d  
 d m o t l n th m g u l Th l o f i  
 m l d h d l t t f t e t l p h n t e  
 F g C o e t g o g m N 54 C y t g m  
 t k m t h s f t e p e t The b l d d t l  
 m l Th l f i r g u l d h d l t  
 t f t h t l p h t R d l e l l d d  
 c a p a c i t y 375 b t m t s  
 I g C e t g g m N o C y t g m

t k t m n t h f t p e t s h b l d d r s m h t  
 l t h m g m h t g u l The g f t h  
 e l h c m t h d s h o w n d l t a t f t h  
 l t l p h t l d l b l a d d e p t y 3 5  
 b c c t u m t  
 F g 4 C r t g m N 53 C y s t a m  
 t k n l m t h s f t p t The b l a d d e r t h n  
 r m a l Th l f i g u l d s h w s  
 d l t t o f t h t r n l s p h t R d l r n  
 b l a d d p t y 3 c b c t m t

were obtained during the convalescence of the patients in the hospital. The older case were taken from the living near by and the first 3 cases thus obtained will be reported in detail. The description of these includes the salient points in the rectal examination made by one of the staff on the patient's admission to the hospital recording the amount of prostatic hypertrophy noted per rectum. This is supplemented by a cystoscopic examination and study of the prostate intravesically. In these examinations a cystoscope giving an inverted image was used usually the Nitze photographic model. Only the descriptions of the prostate itself are taken from the record and each of these is supplemented by a drawing on a cystoscopic chart as suggested by

Young (16) made at the time of examination graphically to represent the intravesical prostatic hypertrophy. The normal prostatic margin is here outlined in diagonal lines while the superimposed pathological hypertrophy is recorded in black. The operation performed in every case has been Young's (17) conservative perineal prostatectomy done by Young or one of his staff. This operation in brief is a perineal dissection through an inverted V skin incision the patient being placed in the exaggerated lithotomy position. After cutting through the central tendon of the perineum the membranous urethra is exposed and with the bulb and external sphincter muscle drawn forward is incised on a sound previously placed in the urethra. A prostatic

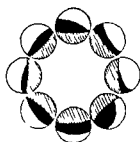


Fig. 5

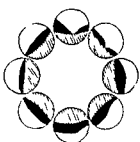


Fig. 7

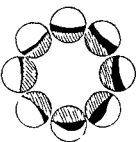


Fig. 9

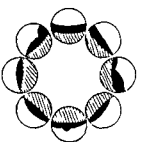


Fig. 31

Fig. 5. Case 13. Globular median lobe continuous with a definite right lateral lobe with hypertrophy. The left lobe is not enlarged.

Fig. 7. Case 14. Collar type of hypertrophy including both lateral lobes joined by an enlarged middle lobe.

Fig. 9. Case 5. Mostly a middle lobe enlargement with no enlargement of the right lateral lobe and only slight involvement of the left lateral lobe.

Fig. 31. Case 16. Globular middle lobe with slight hypertrophy of the right lateral lobe. The left lateral lobe is not appreciably enlarged.



Fig. 6



Fig. 28

Fig. 6. Case 13. Roentgenogram No. 51. Cystogram taken thirteen months after operation. The bladder is round in outline with margins regular. The vesical orifice is normal and there is no dilatation of the internal sphincter. Residual urine, bladder capacity 300 cubic centimeters.

Fig. 28. Case 14. Roentgenogram No. 51. Cystogram taken fourteen months after operation. The bladder is normal in outline. The vesical orifice is regular and shows no dilatation of the internal sphincter. Residual urine, bladder capacity 400 cubic centimeters.



Fig. 30



Fig. 32

Fig. 30. Case 15. Roentgenogram No. 563. Cystogram taken four months after operation shows bladder outline normal with margins irregular. Region of vesical orifice smooth with no dilatation of the internal sphincter. Residual urine, bladder capacity 400 cubic centimeters.

Fig. 32. Case 6. Roentgenogram No. 544. Cystogram taken fifteen months after operation shows bladder outline normal with prostatic margin smooth and there is no dilatation of the internal sphincter. Residual urine, bladder capacity 400 cubic centimeters.

tractor is then placed through the urethrotomy opening into the bladder and with this the prostate is drawn up into the wound. The rectum is then pushed back and the prostate exposed, covered only with the anterior layer of the fascia of Denonvillier. Two perpendicular incisions are then made through the capsule and posterior lobe on either side of the midline, avoiding in this way the ejaculatory ducts. Through these incisions the hypertrophied lateral and middle lobes are enucleated. A large catheter is then placed through the urethrotomy wound into the bladder and the lateral cavities of the prostate are packed with gauze. The levator ani are then brought together with a single suture and the skin approximated.

In every case is noted the beginning of interval urination indicating from a functional standpoint the return of control in the internal sphincter. The study of the vesical orifice was made in these cases by means of cystograms taken some time subsequent to operation, i.e., three weeks to thirteen years. These were made after filling the bladder with 10 per cent thorium solution through a catheter as recommended by Burns (18) and studying the bladder outlines and particularly the region of the prostatic orifice for evidences of dilatation as shown by the escape of the thorium solution into the posterior urethra.

CASE 1. C. M. C.—B. U. I. No. 523/63—W. Complaint: difficulty in urination.



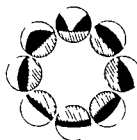


Fig 39

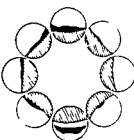


Fig 41

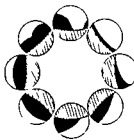


Fig 43

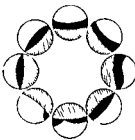


Fig 45

Fig 39. Case 20. A triple lobe hypertrophy of the right lateral lobes joined by a considerably enlarged middle lobe.

Fig 41. Case 21. Very slight hypertrophy of the right lateral lobes with a normal middle lobe. Adenolargement of the suburethral or Holm's gland.

Fig 43. Case 43. A large middle lobe confluent with a large middle lobe. The left lateral lobe is only slightly enlarged.

Fig 45. Case 45. Hyper trophy of both right and left lateral lobes. The junction enlarged middle lobe incl. bifurcated.



Fig 42



Fig 44



Fig 46



Fig 48

Fig 42. Case 20. roentgenogram No 543. Cystogram taken 2 years and 4 months after operation. The bladder outline is somewhat oval and margins are irregular. The vesical orifice is smooth and shows no dilatation of the internal sphincter. Residual urine 0.5 cubic centimeters.

Fig 44. Case 20. roentgenogram No 545. Cystogram taken 2 years and 4 months after operation. The bladder outline is oval with margins regular. The region of the prostatic orifice is smooth and shows no dilatation of the internal sphincter. Residual urine 0.5 cubic centimeters.

Fig 46. Case 2. roentgenogram No 555. Cystogram taken 4 years after operation shows bladder outline round with margins quite regular. The region of the vesical orifice is smooth and shows no dilatation of the internal sphincter. Residual urine 0.5 cubic centimeters.

Fig 48. Case 23. roentgenogram No 566. Cystogram taken 8 years after operation shows bladder outlines oval with margins regular. The vesical orifice is smooth and shows no dilatation of the internal sphincter. Residual urine 0.5 cubic centimeter. bladder capacity 2 cubic centimeter.

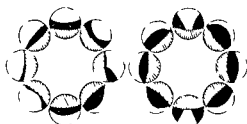
CASE T. D. — B. U. I. No 5023. 63-W. Complaint frequency urgency with some burning on urination.

Rectal examination. Prostate is apparently not much hypertrophied—is about normal width. Median furrow and notch shallow. The right lobe is possibly a little indurated and adherent otherwise negative. Left lobe is the same no nodules and no tenderness made out.

Cystoscopy. Residual urine 300 cubic centimeter. Bladder capacity 800 cubic centimeters. Study of the prostatic orifice shows no cleft anteriorly. There is slight rounding of the right lateral lobe which is continuous with a fairly pronounced median lobe as shown in chart. On the left there is a slight depression between it and the left lateral—the left lateral lobe—is only slightly larger than normal intravaginally.

Operation. On exposing the prostate it was found to be small and no larger than normal. The usual two incisions were made into the capsule and two small pieces of nonhypertrophied tissue removed from each lateral cavity. The finger was introduced into the bladder and there was found a flat slightly irregular lobe lying on the trigone. This was freed with the finger and subsequently delivered into the left lateral cavity. The lobe was flat and definitely hypertrophied and rather firmly adherent to the bladder wall beneath. This was undoubtedly an Albarran lobe and did not communicate with the lateral cavities there being no hypertrophy of the lateral lobes nor in the suburethral or median lobe. Patient voided at interval on the seventh day after operation.

CASE 3. W. B. F. — B. U. I. No 5136. 33-M. Complaint Retention of urine.



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trigone. There is also hypertrophy of the right lateral lobe.

*Operation.* After incisions into the posterior capsule on either side of the midline a larger lateral lobe was shelled out from the left side; this lobe measured about 5x4x4 centimeters. A similar lobe from the right side probably containing some median lobe was also enucleated. The sphincter was felt to contract tightly around the finger and there was no further prostatic tissue obcurring the orifice.

The patient voided at interval on the fifth day after operation.

CASE 6 J M W—B U I No 48 6 60 M  
Complaint retention of urine

*Rectal examination.* Finger immediately encounters a soft bulging mass, surface smooth, contour rounded. The prostate is very soft, quite elastic. One reaches with difficulty the base of the prostate and there is considerable increase in the breadth of the prostate.

*Cystoscopy.* Examination of the vesical orifice shows a good sized intravesical enlargement. Directly anterior there is a shallow cleft with a very large right lateral which projects very markedly into the bladder particularly anteriorly. The right lobe is continuous with the median there being apparently no cleft separating the lateral from median portion. The left lateral lobe is distinctly enlarged, projects into the bladder as a rounded edge but it is very much smaller than the right lateral.

*Operation.* The prostate was exposed without much difficulty and was only slightly enlarged. The lateral lobes were enucleated each in two or three pieces being small. The median portion came away partly through the left lateral with the assistance of the finger in the bladder.

Examination showed a well preserved sphincter, a very small lobule about as big as a pea on the left side which we did not succeed in removing.

Patient voided at intervals on the seventh day after operation.

CASE 7 H G—B U I No 4 76 6 M  
Complaint painful and frequent urination

*Rectal examination.* Prostate is flat, a little broader than normal. Median furrow and notch shallow. The left lobe seems to be definitely hypertrophied being lobular but small and enlargement is present. On the right side the lobe is flat and if there is hypertrophy present it is small. Both lobes are adherent externally both moderately indurated.

*Cystoscopy.* Residual urine 50 bladder capacity 80 cubic centimeters. Shows slight rounding anteriorly with a very shallow cleft just to the left of the mid line. There is practically no intravesical enlargement of either lateral lobe and the median is not intravesically enlarged. Further study shows slight rounding of the median lobe which may account for the residual. With finger in the rectum and the cystoscope in the urethra there is considerable median thickening with definite collar around the beak of the cystoscope so that the outlines of the beak cannot be definitely felt.

*Operation.* The lateral lobes were small and were removed with difficulty. The left was removed first. It was the larger of the two and measured roughly about 1x1½ centimeters. The right was smaller and more adherent. Both were hypertrophied. Attempt was made to remove a suburethral portion which lay beneath the ejaculatory bridge. Difficulty was encountered because of fibrous adhesions and it was decided to cut through the ejaculatory bridge above. The suburethral portion was peeled off from the mucosa apparently without injury to it. This showed definite hypertrophy and was somewhat larger than the two laterals together. The ejaculatory bridge was stitched back in position.

Patient voided at intervals on the fifteenth day after operation.

CASE 8 L C W—B U I No 46 6 47 M  
Complaint frequency of urination associated with pain and burning

*Rectal examination.* Bladder evidently considerably dilated and presses well back toward the rectum. The prostate is pressed downward by the greatly distended bladder and is apparently not much hypertrophied. Median furrow and notch shallow. Right lobe is slightly irregular, moderately indurated but not much enlarged. Left lobe is similar to the right.

*Cystoscopy.* Residual urine 115 cubic centimeters bladder capacity not obtained. No cleft anteriorly. Right lateral lobe is not enlarged, middle lobe enlarged in the shape of a sessile rounded intravesical hypertrophy of fairly considerable size and a deep sulcus on either side as shown. Most of the trigone is obscured.

*Operation.* The prostate was easily exposed without injury to the triangular ligament, external sphincter or rectum. Posterior surface was only moderately larger than normal and the lateral lobes were small showing very little evidence of hypertrophy. The median lobe which came away through the right lateral cavity and through a rent in the urethra was about 3 centimeters in diameter, very adherent and entirely intravesical. The sphincter was somewhat dilated but not injured.

Patient voided at intervals on the ninth day after operation.

CASE 9 J S—B U I No 4613 66 M  
Complaint retention of urine. Hematuria

*Rectal examination.* Prostate moderately enlarged, smooth elastic, moderately indurated, not nodular, slightly adherent on each side.

*Cystoscopy.* Retention. Residual urine 175 cubic centimeters. Study of the prostatic orifice looking anteriorly shows a globular lobe as the right which is apparently a right lateral which is rounded and moderately hypertrophied intravesically. The median lobe is irregular and projects well into the bladder with a shallow sulcus between it and the right lateral. The middle lobe projects more to the left and there is a fairly deep sulcus between it and the left lateral lobe which does not seem to be intravesically hypertrophied.

*Operation* Prostate was moderately enlarged and was removed with some difficulty owing to the deep adhesions. The median portion of the prostate came away partly through the right and partly through the left lateral cavity. Examination then showed a phinct somewhat dilated no remaining enlargement present.

Patient died at interval on the third day.  
**CASE 10 J D I — B U I No 455 50 W**  
 Complaint difficulty in urinating hematuria and painful voiding.

*Rectal examination* Prostate much bader than normal does not project much into the rectum. The right lobe is a nout and the left lobe is smooth moderate ly indurated partly long the outer edge no nodules tenders. The left lobe also medially enlarged smooth. The left lobe is normal lightly adherent externally.

*Cystoscopy* Retention. Bladder capacity 300 cubic centimeters. Orifice a little irregular. Left ureter only. The right lobe lightly rud but not much irregularly hypertrophied. The median portion of the prostate is indurated in the shape of a median edfily glubular. There is a fairly deep ulcer between it and the right lobe. Left lobe is curved by blood apparently not much thickened by hypertrophy.

*Operation* Prostate moderately enlarged. The right lateral lobe was easily removed in one piece measuring 3 centimeters. The left lobe came away in numerous small pieces urethra being required. Part of the lobe projected anteriorly in front of the urethra. The intra-urethral portion of the prostate was in two pieces apparently a globular lobe projecting from the right into the bladder but probably median. The transverse peduncle of the prostate is a lobe which projected into the bladder apparently from the left side. Internal sphincter was dilated but apparently not torn.

Patient died intervals in the seventh day after operation.

**CASE 11 W L F — B U I No 440 8 W**  
 Complaint frequency pain and burning in urination.

*Rectal examination* The prostate moderately enlarged. Median furrow and not ha shallow. The right lobe is moderately hypertrophied. The left lobe of the prostate is similar to the right slightly indurated glubular moderately adherent. There is nothing to suggest malignancy.

*Cystoscopy* Retention. Bladder capacity 300 cubic centimeters. Study of the prostatic orifice shows a glubular median lobe some hat duplex in character and more closely associated than the right than the left lateral. The left lateral is not intravesically hypertrophied.  
*Operation* Prostate as difficult to expose as to a great deal of bleeding and marked adhesions. The prostate as moderately enlarged and the lateral lobes were removed each in one piece measuring about 3.5 centimeters. The middle lobe came away through the right lateral cavity being

to indicate that is more right lateral than median—though it is so movable that it is difficult to tell just where it springs up.

*Operation* Prostate was easily exposed. The lateral lobes were moderately enlarged and each removed largely in one piece. Two or three small lobules were removed later. The median portion of the prostate came away with the deeper part of the right lateral lobe as about centimeters in diameter. Examination showed a sphincter which was hardly dilated. There is no fibrosis about it. The patient permitted patient voided at regular intervals.

**CASE 12 H M — B U I No 4399 63 M**  
 Complaint retention of urine.

*Rectal examination* Prostate is very much broader than normal presents considerable grade of hypertrophy. The median furrow is almost obliterated. The right lobe is prominent with a lightly irregular surface very sticky much more so than usually found in the case laterally it is quite adherent. The left lobe is about the same size as the right irregular on its surface and more indurated than the other side although it is quite elastic.

*Cystoscopy* Bladder capacity 400 cubic centimeters. Study of the prostatic orifice shows a very wide cleft anteriorly. Both lateral lobes are about equally enlarged laterally and continuous with a median which obduces practically all of the trigon. Except for the cleft anteriorly the ureters are no other lefts made out.

*Operation* Prostate moderately enlarged. The lateral lobes were removed in one piece and the median lobe was removed in an hour in diameter. It was removed through the right lateral cavity. Internal phincter completely eradicated though dilated.

Patient voided at intervals on the ninth day after operation.

**CASE 13 A B — B U I No 4304 5 M**  
 Complaint painful urination with occasional retention and increasing frequency.

*Rectal examination* Prostate considerably enlarged. Median furrow and notch wide and shallow. Right lobe slightly irregular moderately indurated. In some places more than others nothing suggests malignancy no adhesions. The left lobe larger than the right quite prominent considerably enlarged moderately indurated but still elastic slightly adherent externally.

*Cystoscopy* Residual urine in bladder capacity 500 cubic centimeters. Study of the prostatic orifice shows a glubular median lobe some hat duplex in character and more closely associated than the right than the left lateral. The left lateral is not intravesically hypertrophied.

*Operation* Prostate as difficult to expose as to a great deal of bleeding and marked adhesions. The prostate as moderately enlarged and the lateral lobes were removed each in one piece measuring about 3.5 centimeters. The middle lobe came away through the right lateral cavity being

smaller about 1.5 centimeter in size. Examination showed the vesical sphincter slightly dilated but otherwise uninjured.

Patient voided at intervals on the sixteenth day.

CASE 14 J H L—B U I No 4 49 6, W  
Complaint difficulty in urination—irritability of bladder

*Rectal examination.* Prostate is a great deal broader than normal. Median furrow and notch deep and wide. The right lobe is moderately enlarged, irregular, moderately indurated, considerably adherent externally, induration not of stony hardness, compressible and elastic on deep pressure. The left lobe is smoother than the right, globular, moderately enlarged and indurated, compressible on deep pressure.

*Cystoscopy.* Residual urine 60 cubic centimeters, bladder capacity 50 cubic centimeters. No cleft anteriorly. Prostate is enlarged in the shape of a collar hypertrophy, consisting of fairly large median bar continuous without intervening sulci with the lateral lobes. There is a peculiar anterior lobe which lies to the right of the median line when the handle of the cystoscope is elevated. There is no enlargement of the left lateral lobe. The median portion of the prostate is considerably enlarged, elevated well above the trigone so that it is difficult to see the ureters.

*Operation.* The prostate was easily exposed without injury to the external sphincter or triangular ligament. It was markedly enlarged. The left lateral lobe was removed almost completely in one piece. The right lobe was smaller. It was removed in several small pieces. The median portion of the prostate came away in two portions through the right and left lateral cavities. Examination showed that the sphincter was well preserved.

Patient voided at intervals on the fourteenth day after operation.

CASE 15 W E—B U I No 4281 69 W  
Complaint difficulty and frequency of urination

*Rectal examination.* The prostate is a little broader and more prominent than normal. Median furrow and notch are shallow and broad. The right lobe is slightly enlarged, moderately indurated and adherent, not nodular, not tender. Left same as right.

*Cystoscopy.* Residual urine 40 cubic centimeters, bladder capacity 175 cubic centimeters. No enlargement of the lateral portions. The median portion is elevated in the shape of a small rounded bar with a shallow sulcus on each side as shown. The right lateral lobe is not enlarged. The trigone is obscured in its anterior third by the median bar. With finger in rectum and cystoscope in urethra the median portion of the prostate is only slightly thicker than normal, the lateral lobes are very little larger than normal and not markedly indurated.

*Operation.* The lateral cuts were made through the indurated tissue, the lateral lobes were covered with a few small spheroids, each lateral lobe being very little larger than normal and not encapsulated as usual. Each came away in two or three small

pieces measuring  $1\frac{1}{2} \times 2$  centimeters in size. The median portion was removed partly through the left and partly through the right lateral cavity. A slightly sclerotic sphincter was made out and dilated with the finger and also with the glove stretcher.

Patient voided at intervals on the twenty seventh day after operation.

CASE 16 A Y—B U I No 42 66 M  
Complaint hesitancy, slight frequency and urgency

*Rectal examination.* Prostate moderately enlarged, consistency elastic, no areas of marked induration felt. No stony hardness felt. The right lobe seems slightly more hypertrophied than the left. Off to the side of the left lobe are felt one or two small shot lime masses which are apparently glands. These however do not seem particularly hard. Median furrow shallow.

*Cystoscopy.* Residual urine 40 cubic centimeters, bladder capacity 450 cubic centimeters. Study of the prostatic orifice shows at once the presence of a large globular median lobe. There is no cleft anteriorly. The right lateral lobe is somewhat rounded and between it and the median is a cleft of moderate depth. The left lateral lobe is not intravesically hypertrophied but there is a cleft between it and the median lobe. The median covers the entire trigone obscuring both ureteral orifices. On looking directly posterior a small globular swelling apparently attached to the enlarged median can be seen, probably a small prostatic lobule or thick walled cyst.

*Operation.* A suburethral lobe spherical in shape and measuring 1 inch in diameter was first discovered. It was brought into the right lateral cavity and enucleated without difficulty. Examination showed no lateral enlargement. A large subtrigonal median lobe however was found. This extended quite far anteriorly both on the right and left side and was densely adherent. This was removed only after considerable difficulty. Examination of the vesical orifice now showed the complete removal of all obstruction.

Patient voided at intervals on the twenty eighth day.

CASE 17 E F S—B U I No 4212 6 W  
Complaint retention of urine

*Rectal examination.* Prostate is moderately hypertrophied, placed rather high. It is smooth, elastic, symmetrical. Median notch and furrow obliterated. Somewhat adherent externally and above, no areas of stony hardness made out.

*Cystoscopy.* Residual urine 00 cubic centimeters, bladder capacity 225 cubic centimeters. Study of the prostatic orifice shows intravesical enlargement of the right lateral and median portion, being in the shape of a rounded globular median bar.

*Operation.* Two lateral lobes each measuring  $1\frac{1}{2} \times \frac{1}{2}$  inches were removed from their respective cavities. Examination showed the presence of an intravesical median lobe which extended laterally well up on the right side. By manipulating the prostatic tractor this lobe was brought into the



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Cystoscopy Residual urine 170 c bic centimeters  
bladder capacity 310 cubic centimeter Cystoscope

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l be and median bar conti ou v th the t v o

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C A s t J B—B U I No 4388 6 M

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and th ureth l l e th greatly incre sed Cyst  
c py sho t n e a very large r ght l be p o

jecting far int the blad l r L f t lobe does n t s em  
t be very much hypertrophed M d a l be r n t

once into the right lateral lobe. Median lobe evidently in the shape of a bar.

**Operation.** Prostate was easily exposed. It was considerably enlarged and enucleated without difficulty but apparently completely. The phincters were apparently not injured.

Patient voided at intervals on the twentieth day after operation.

**CASE 23. E. C.—B. U. I. No. 11432 M.** Complaint: frequency and burning of urination. Difficulty in starting stream.

**Rectal examination.** Prostate is considerably enlarged much broader than normal. It is a little irregular in places soft at others hard nowhere of dense induration. Median furrow and notch very indefinite. There are no adhesions, no tenderness.

**Cystoscopy.** Residual urine 230 cubic centimeters. bladder capacity 300 cubic centimeters. The cystoscope shows moderate enlargement of both lateral lobes and a large median lobe which is divided into two folds with a deep cleft between them as shown in the drawing. When the beak of the instrument is turned down and the shaft depressed you see the right lobe. The right portion of the median and the left portion of the median as shown.

**Operation.** Two incisions were made on each side of the urethra and two lateral lobes enucleated with the finger—a small median lobe was also removed in this case.

Interval urination started on the fifth day.

**CASE 4. M. R.—Gen. No. 160634 M.** Complaint: retention of urine.

**Rectal examination.** Prostate much enlarged and bulging posteriorly into rectum. Symmetrical—fairly hard not tender. Palpating finger cannot reach over it.

**Cystoscopy.** Cystoscopy attempted but unsatisfactory on account of sharp hemorrhage from prostatic urethra. With cystoscope in the urethra and finger in the rectum the median mass is found to be quite considerable.

**Operation.** The two lateral lobes were pressed out through the incision by blunt dissection. Median enlargement was turned to the right and pressed out last.

Patient voided at interval on the twenty-first day after operation.

**CASE 5. W. F. S.—B. U. I. No. 17333 M.** Complaint: retention of urine.

**Rectal examination.** Prostate considerably enlarged and both lateral lobes and median furrow is broad. Notch at upper end obliterated. Lateral lobe bulge moderately toward the rectum but their upper ends can be easily reached by finger. Consistence soft elastic contour smooth and no nodules present.

**Cystoscopy.** Cystoscope shows a large rounded intravesical outgrowth from each lateral lobe between these two the urethra is compressed laterally and with the cystoscope looking downward a narrow chink is seen between the two enlarged lobes in the urethra. Superiorly the lobes do not press together so tightly. The left lobe is larger and pro-

jects farther into the bladder than the right. In the median portion there is a thin fold of mucous membrane which connects the two lateral lobes. The hypertrophy therefore consists of two bulging lateral lobes which compress the urethra between them.

**Operation.** The capsule was divided on either side of the median furrow by means of blunt dissection and the finger the enormously hypertrophied lateral lobes of the prostate were stripped out. Each lobe seemed lobulated and was removed in several pieces each piece in turn being drawn into the wound by aid of the tractor and stripped out. The lobes were very adherent to the bladder mucosa where the Bottini operation had been previously done.

Patient voided at interval on the thirteenth day after operation.

#### SUMMARY OF CASES

1. C. M. G.—B. U. I. No. 5237 Cystogram No. 608 3 weeks after operation Internal sphincter closed
2. T. D.—B. U. I. No. 503 Cystogram No. 36 3 weeks after operation Internal sphincter closed
3. W. B. F.—B. U. I. No. 5136 Cystogram No. 583 3 weeks after operation Internal sphincter closed
4. A. C. L.—B. U. I. No. 508 Cystogram No. 504 weeks after operation Internal sphincter closed
5. C. M. B.—B. U. I. No. 541 Cystogram No. 603 5 weeks after operation Internal sphincter closed
6. J. M. W.—B. U. I. No. 486 Cystogram No. 388 4 months after operation Internal sphincter closed
7. H. G.—B. U. I. No. 456 Cystogram No. 498 3 months after operation Internal sphincter closed
8. E. C. W.—B. U. I. No. 466 Cystogram No. 513 6 months after operation Internal sphincter closed
9. J. S.—B. U. I. No. 4613 Cystogram No. 508 months after operation Internal sphincter closed
10. J. D. P.—B. U. I. No. 458 Cystogram No. 340 7 months after operation Internal sphincter closed
11. W. L. F.—B. U. I. No. 4490 Cystogram No. 607 10 months after operation Internal sphincter closed
12. H. M.—B. U. I. No. 4399 Cystogram No. 523 11 months after operation Internal sphincter closed
13. A. B.—B. U. I. No. 4304 Cystogram No. 511 13 months after operation Internal sphincter closed
14. J. H. L.—B. U. I. No. 4249 Cystogram No. 114 months after operation Internal sphincter closed
15. W. E.—B. U. I. No. 418 Cystogram No. 563 14 months after operation Internal sphincter closed
16. A. Y.—B. U. I. No. 4220 Cystogram No. 344 15 months after operation Internal sphincter closed
17. E. F. S.—B. U. I. No. 4212 Cystogram No. 316 months after operation Internal sphincter closed
18. M. I.—B. U. I. No. 4176 Cystogram No. 690 months after operation Internal sphincter closed
19. G. S.—B. U. I. No. 4176 Cystogram No. 690 months after operation Internal sphincter closed
20. J. J. J.—B. U. I. No. 395 Cystogram No. 43 2 years 4 months after operation Internal sphincter closed
21. J. B.—B. U. I. No. 4388 Cystogram No. 52 2 years 4 months after operation Internal sphincter closed
22. G. W. S.—B. U. I. No. 308 Cystogram No. 3 4 years after operation Internal sphincter closed

|    |              |            |               |      |
|----|--------------|------------|---------------|------|
| 3  | EC—BUI N     | 74         | Cy t g r m N  | 568  |
| y  | rs ft        | pe at on   | Int r l ph ct | lo d |
| 4  | MR—G n l N   | 606        | Cyst r m No   | 58   |
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| 5  | WFS—BUI N    | 73         | Cy t g m N    | 593  |
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## SUMMARY

From a study of the cases herewith reported it is seen that following perineal prostatectomy the internal or vesical sphincter returns to its normal tone and function in every instance. This takes place within a few weeks as demonstrated by the accompanying cystograms. From clinical observations we are led to suspect an even earlier return of function judging from the establishment of definite intervals of urination a few days after prostatectomy has been performed with a perineal urethrotomy in the membranous urethra back of the internal sphincter as it should be. Not infrequently urine is voided at three and four hour intervals at this period both through the urethra and through the urethrotomy wound while during the intervening time the patient is perfectly dry. These rather long periods of complete continence could not occur under the above conditions if the vesical sphincter were not functioning normally.

On interesting case 18 in which the vesical sphincter was found closed and functioning normally twenty months after operation (cystogram No 679) at an earlier examination fourteen months after operation was found to be dilated (cystogram No 508) with the posterior urethra funnel shaped and virtually forming a part of the bladder cavity. During this time the patient had periods of incontinence which however had entirely disappeared at his last examination.

In referring to the operative note in this case it is seen that the operator states of the vesical orifice —it lay very deep the tip of the finger passing just within the internal sphincter. The margins of the orifice were grasped with clamps and the structure pulled down into the wound. This procedure undoubtedly injured the sphincter to a degree sufficient to account for the long delay in its restoration of function. It is of interest to note in this instance however that even after an interval of over a year there was complete recovery of function and anatomical relationship.

My thanks are due Hugh H. Young, M.D., for the assistance in the preparation of this paper. The assistance of the following is also acknowledged: Dr. J. M. Bu h an, Dr. W. L. G. I. I. t t t e f h k d, Dr. S. N. p l c n g t h a b o m t l t m y d p o l d t, Dr. Ch r l A W t r o f t h D p t m t f R t g e l y f t, Dr. h p t k m k g t h t p l t.

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|--------|-------|------|--------|---------|----------|-------------|
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| 4      | REH   | i    | v ch   | A       | h f p th | A t t B l   |
| 80     | N     | 5    |        |         |          |             |
| 5      | V E   | K R  | d      | LICH EN | RC       | M h n med   |
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| 8      | BURNS | J    | An M A | 9       | l        | 6           |

THE ACUTE ABDOMEN<sup>1</sup>

By F. GRIGORY CONNELL, M.D., F.A.C.S., OSHKOSH, WISCONSIN

THE acute abdomen might seem a subject upon which at the present time but little remains to be said but increasing experience seems to justify its careful consideration and division into two classes as follows:

- 1 Those that may be remedied by abdominal operations
- 2 Those that may not be remedied by abdominal operations

The first class is of course in the majority as a general rule it does not necessitate differential diagnosis as it makes no difference to the patient and it makes no difference in the first steps of the treatment whether the cause of the trouble is a ruptured appendix, a perforation of a gastric or duodenal ulcer, a cholecystitis or one of the many other causes of such symptoms as long as the condition is remediable by an operative procedure subsequent to laparotomy. The symptoms call for exploratory laparotomy which is automatically followed by the proper diagnosis and in turn rational therapeutics. In such cases the problem is absurdly simple and the fate of the patient rests not so much with the operator who repairs the lesion as with the physician who first sees the case and suspects serious damage.

The repair of reparable damage of the abdominal viscera (granting the presence of surgical judgment on the part of the operator) is comparatively simple on the other hand the cure of peritonitis, the result of such damage is difficult.

This class of cases comprising the majority of abdominal emergencies will not be discussed because the principles of treatment are well outlined and the conditions are recognized and discussed freely in textbooks and current literature.

The second class demands attention, serious consideration and emphasis because these conditions are but rarely differentiated from class 1 with the resultant ineffectual if not detrimental line of treatment. The lesions

may be divided into (1) extraperitoneal which may simulate intra abdominal disease and (2) intraperitoneal (non operable) which may simulate operable conditions.

The extraperitoneal lesions may include thoracic retroperitoneal nervous and others.

## THORACIC LESIONS

*Pneumonia* Confusion between the early stages of pneumonia and acute appendicitis is not so uncommon as might be expected. The general statement is frequent that pneumonia may in its early stages be mistaken for acute abdominal complaints but detailed reports of such instances are not frequent. Some cases of pneumonia after operation for acute appendicitis in which the operative findings are not quite characteristic might possibly have been cases of obscure and undetected pneumonia before operation. Post operative pneumonia should be lobular not lobar.

One of the reasons for this confusion is that often during the first 4 hours of pneumonia the pulmonary symptoms and physical signs in the chest may be entirely absent.

Pneumonia of the right lower lobe can especially in children by irritating the tenth, eleventh and twelfth intercostal nerves produce pain, rigidity and tenderness in the right side of the abdomen which accompanied by the fever, leucocytosis and vomiting of the pneumonia will closely simulate an acute appendicitis.

In pneumonia the abdominal tenderness is less characteristic and usually situated higher the resistance is less marked but may be the same as in appendicitis. On the other hand severe inflammation of the appendix may cause diminution of the respiratory excursion and in the breath sounds of the right lower lobe in this way tending to make the diagnosis still more difficult.

The important point is to *think* of the possibility of pneumonia giving rise to the symptoms in question notably in children.

with rapid respiration and pulse high temperature and dilatation of the aortic arch. Such symptoms call for a careful chest examination not confined to the anterior aspect. In most cases such an examination settles the diagnosis.

**Diaphragmatic pleuritis.** Capps has found that the *isceral* pleura is not sensitive to pressure or scratching of a wire that such irritation of the *parietal* pleura produced pain but that irritation of the outer margin of the diaphragmatic pleura supplied by the lower six intercostal nerves is followed by reflex pain in the hypochondrium and often in the abdominal wall as far down as the navel or even the groin and when the central portion is irritated the pain is referred by the phrenic to the neck by the third and fourth cervical nerves. Capps presents a study of 61 cases of diaphragmatic pleurisy 39 of right side 1 left side 1 bilateral in which referred abdominal pain occurred in 54 cases and there was referred neck pain in 53 cases or about 50 per cent.

While aspirating fluid from the pericardial sac in a recent case I was able to cause pain in the left side of the neck by irritating the lower portion of the pericardial sac.

The following 3 mistaken diagnoses were made in the series of 61 cases of diaphragmatic pleurisy 9 appendicitis 6 cholecystitis 2 perforation of ulcer of the stomach 1 liver abscess 1 peritonitis 1 renal calculus 1 infectious lumbago and 1 brachial neuritis.

Capps conclusions are as follows:

The skin and muscles of the abdomen are more sensitive to pain in referred pleural pain than in visceral diseases. Thus the best elicited by the pinching of the wall and the scratching of the skin.

The cutaneous reflexes remain relatively unaffected pain than in visceral diseases as a rule.

Deep pressure with the flat surface of the finger is well borne in referred diaphragmatic pleural pain while it elicits a dull deep pain when applied over an inflamed organ e.g. an appendix or gall bladder.

Landscapes of respiratory infection are usually present in diaphragmatic pleurisy such as a cough expectoration herpes of lip or throat high leucocytosis rapid respiration etc.

Appearance of a sharply delimited palpable pain in the neck on the same side as the abdominal pain often reveals the true condition since it points to irritation of the phrenic nerve.

The referred pain in the neck and abdomen a

usually induced or aggravated by cough and deep inspiration.

Nausea and vomiting are more constant in the case of abdominal inflammation but may be pronounced in diaphragmatic pleurisy.

Hiccough is not a common symptom in diaphragmatic pleurisy contrary to the current belief. It was present only 1 times in 6 cases. It is more often seen in visceral disease of the abdomen than in diaphragmatic pleurisy.

#### CARDIAC LESIONS

**Angina pectoris** is characterized by epigastric pain after eating or after exertion and is relieved by belching because of these characteristics the milder types of the disease are frequently mistaken for attacks of acute indigestion and more rarely and under rather unusual conditions the more severe attacks may be confused with acute abdominal conditions. In angina pectoris the pain is due to exertion not food the blood pressure is usually high and the heart rarely normal. The attack is accompanied by great fear or apprehension of approaching death. The pain is usually referred to the left arm but may be referred to the back epigastrium testes leg or right arm.

The appearance of the facies is characteristic the features are sunken the face pale and cold with an expression of agony anxiety and distress quite similar on superficial examination to the facies hippocratica.

Emphasis should be laid on the resemblance of some of these cases to surgical accidents. The sudden onset with pain over the lower sternal and epigastric region the nausea and vomiting the tympany the feeble pulse the livid color cold sweat and other signs of collapse make one think of certain acute abdominal conditions.

Where there is arterio-sclerosis enlarged heart a history of previous angina typical radiation of the pain in the neck and arm the diagnosis will not be so difficult as where these suggestive aids are lacking.

**Pericarditis.** In acute pericarditis the symptoms are those of an acute infection. The disease is characterized by pain in the region of the heart. This pain may be referred to the abdomen to the region of the stomach gall bladder or appendix. A careful examination will usually reveal tumultuous heart

action dyspnoea cyanosis dysphagia friction rub and with effusion enlarged cardiac dullness Fluoroscopic examination is of great value

Fussell has seen pericarditis mistaken for appendicitis but states that the mistake rarely occurs in the reverse way (I have been called to operate upon a case for cholecystitis in which the examination revealed a pericarditis with friction rub)

#### RETROPERITONEAL LESIONS

*Renal* Among the renal conditions that might be confused with intra abdominal lesions should be mentioned (1) stone (2) Dietl's crises (3) unilateral hæmatogenous infection of the kidney the septic infarct of Brewer (4) uræmia (5) perinephritic abscess and (6) pyelonephritis The most frequent is stone Renal colic is characterized by severe pain usually calling for morphine with tenderness in the loin and vesical tenesmus with nausea or vomiting and hæmaturia with no increase in temperature or leucocytosis The symptomatology of renal lithiasis has been very exhaustively studied by Braasch who found great variations in the usually accepted signs and symptoms For example typical pain and tenderness in the kidney region was present in only 117 of 251 cases in 26 pain was general abdominal in 30 pain referred to gall bladder in 32 pain referred to lower abdomen in 56 pain referred to both sides of abdomen in 40 pain referred to affected sides of abdomen in 16 pain referred to non affected side of abdomen Thus one is justified in concluding that the pain of renal lithiasis may be very atypical

Braasch likewise found that hæmaturia was present in 141 of 51 cases or 56 per cent a rather indefinite percentage and to make matters worse in 500 consecutive routine examinations in cases without symptoms of renal trouble 146 showed microscopic blood in the urine

Cabot in 150 cases of renal and ureteral stone found the urine persistently normal in 14 per cent hæmaturia absent in 3 per cent

The presence of microscopic blood in the urine may be due to pathology in any part of

the genito urinary tract The mere fact that there is an acute abdominal inflammation may cause microscopic hæmaturia

The contact of an acutely inflamed appendix with the ureter or bladder may give rise to blood in the urine Lising reports two such cases of pericystitis complicating acute appendicitis and I have seen two cases in which symptoms suggestive of appendicitis with a mass in the pelvis were relieved by the removal of bloody urine from the distended bladder Laparotomy disclosed a gangrenous appendix in contact with the fundus of the bladder

Such cases are not uncommon and too much stress must not be placed upon the presence of a few red blood cells in the urine as indicative of renal colic

The X ray failed to reveal urinary calculi in 10 to 15 per cent of Cabot's and in 11 per cent of Braasch's cases

Confusion between abdominal conditions and kidney stone was emphasized by the late Maurice Richardson who wrote an extensive article the last before his death on The Error of Overlooking Ureteral Stone Under a Diagnosis of Appendicitis and Hugh Cabot reported 157 cases of stone in the kidney and ureter in 26 of which unnecessary abdominal operations had been performed These operations were distributed as follows

|                             |    |
|-----------------------------|----|
| Appendectomy without relief | 10 |
| Exploratory laparotomy      | 7  |
| Fixation of kidney          | 4  |
| Operation for gall stones   | 1  |
| Decapsulation of kidney     | 1  |
| Salpingo oophorectomy       | 1  |
| Suprapubic cystotomy        | 1  |
| Adhe. to S.                 | 1  |
|                             | 26 |

And in a recent contribution Braasch states that 143 or practically one third of the total number in his series of cases of nephrolithiasis had had previous laparotomies performed elsewhere for relief of pain 83 with stone in right kidney 55 with stone in left kidney 5 with stone in both kidneys twenty one patients with stone in left kidney had had previous operations on the appendix or gall bladder

*Dietl's crises* is characterized by symptoms that simulate renal colic or intra abdominal

disease such as severe abdominal or lumbar pain nausea vomiting distention rigidity with enlarged tender kidney and variable bladder symptoms with a usual absence of temperature and leucocytosis. This condition is supposed to be due to an acute obstruction of the ureter by kink or torsion of a floating or wandering kidney. It was first described by Dietl in 1864 and its frequency is decreasing with more painstaking examination and more accurate diagnosis.

*Acute hematogenous infection of kidney*  
*acute septic infarct of kidney* Brewer in 1906 analyzed 11 cases and found 11 in women and 11 on the right side. Chill at onset was present in 4. Sudden high temperature 104 at first examination was found in 1. In three cases there were marked remissions in others the temperature was constantly high. In all cases the pulse was rapid over 100. In 1 the chief complaint was abdominal pain in 4 in the right iliac region. The costovertebral angle was tender in all. Muscular rigidity was a frequent finding as was leucocytosis. Microscopic blood was found in the urine of all but one.

In these cases with the sudden onset severe general pain localizing on the right side vomiting with profound constitutional toxic disturbances and few definitely renal symptoms the condition is often mistaken for intra-abdominal infection.

In Brewer's 13 cases an abdominal incision under medical diagnosis was made three times. In Cobb's 8 cases the same mistake was made in 3 instances.

That this type of case is not as uncommon as was previously supposed is shown by the fact that Mason in 1911 collected 8 cases and Cunningham in the same year reported 8 additional cases.

In a personal case 10 days after an unsuccessful abdominal operation nephrectomy was followed by a satisfactory outcome.

*Disease of the suprarenal capsule* Addison's disease or syndrome is characterized by (a) physical and mental inertia (b) pigmentation (c) gastro-intestinal symptoms.

In the last we find anorexia nausea vomiting constipation and later diarrhoea enteropneumia pain in lumbar and iliac regions with

slight rigidity and tenderness on palpation in right iliac fossa which may at times be attributed to intra-abdominal disease.

Study of the suprarenal gland has taught that there is a *cortical* portion that concerns the sexual function and a *medullary* portion that seems to have a double function one concerning pigmentation and the other in the production of suprarenin or adrenalin. This medullary portion consists of connective tissue nerves and cells the most important is the chromaffin cell. This chromaffin is found in the medullary portion of the adrenal in the sympathetic ganglia in the substance of the epididymis and all these combined constitute what is known as the chromaffin system which seems in some way as yet not understood to be intimately connected either as a hypo or hyper function with the endocrinal system.

Addison's syndrome because of the gastro-intestinal symptoms in which the pain at times may be severe may be confused with intraperitoneal disease.

The symptom complex characteristic of Addison's syndrome is not uncommon. The pigmentation will be found very frequently with the other two if it is intelligently looked for. One meets this syndrome frequently in cases that come under observation with a diagnosis of chronic appendicitis but one hesitates to diagnose Addison's disease.

That there may be acute pain in this class of cases is beyond question and Tice cites a case in point. The diagnosis of Addison's syndrome and appendicitis was made. In a subsequent note it is stated that there was exacerbation of the appendicitis which led to transfer to the surgical service and laparotomy was performed at which the findings were negative except for an old adherent appendix which was removed. Death occurred the following day and an autopsy was not permitted. This exacerbation of the appendicitis was evidently a misinterpretation of the symptoms.

Brodutz calls attention to the violent intestinal colic occurring in attacks failure of the peristalsis and isolated intestinal distention. And Ebert says that in the terminal stages there is excessive vomiting

abdominal pain and constipation the abdomen is retracted and the walls tense the pulse becomes small and there exists *in toto* the picture of peritonitis

Hæmorrhage or suppuration may lead to sudden destruction of the suprarenal glands. This condition is but rarely recognized was first described by Virchow and is characterized by very severe symptoms together with peritonitis which ends rapidly in death.

*Uræmia* In certain cases of uræmia acute abdominal pain distention with severe vomiting and fever may be present. Differential points are urine examination blood pressure hypertrophy of heart.

The acute abdominal pain of nephritis particularly of the hæmorrhage type has been emphasized by Osler.

*Perinephritic abscess* Perinephritic abscess may simulate peritoneal disease but careful history and examination will usually prevent confusion.

*Pyelonephritis* Pyelonephritis is undoubtedly a cause of pain in the right side of abdomen that may lead to erroneous diagnosis. In 90 cases of proved pyelonephritis entering Cook County Hospital in 1917 Culver found that the entrance diagnosis included almost every possibility. In two personal cases in which symptoms persisted after appendectomy catheterization of the ureter showed a pyelitis of the right kidney.

*Genito urinary tract in the male* Inflammation of the epididymis prostate gland or the seminal vesicles may cause pain and tenderness in the right iliac fossa as likewise may small hernia.

*Orthopedic conditions* Orthopedic conditions such as caries spondylitis deformans or hypertrophic arthritis of the vertebræ subluxations of the sacro iliac or lumbosacral articulations or the presence of an abnormal transverse process of the fifth lumbar vertebra are all of importance in a consideration of atypical abdominal pain. They usually give rise to chronic symptoms but occasionally may cause acute pain and other symptoms that may simulate intra abdominal lesions. They may be suspected by limitation of motion of the spine with local tenderness over vertebræ or lumbar regions.

R C Cabot reports 17 cases of vertebral tuberculosis (Pott's disease) that came to autopsy only 4 were recognized in life. He says that knuckle in the spine, pressure signs muscular rigidity limitation of motion and secondary abscess are not common.

The important diagnostic point is X ray examination which may show erosion arthritis or deformity but these roentgenograms must be given careful study before arriving at conclusions as the normal X ray picture is not yet definitely accepted.

Cotton in a very concise article on Fractures of the Transverse Processes of the Vertebrae makes the statement that within a year a certain amount of loose literature has appeared concerning fractures of the transverse processes of the vertebrae. It does seem to me that we should refrain from diagnosis or at least from prognosis and cures and even from expert testimony until we have more facts.

In 2 cases classed as fracture of the transverse process of the vertebra in the X ray Department of the Boston City Hospital Cotton was able to find a fracture in only 17 and after briefly abstracting these cases and presenting outline drawings of the roentgenograms in 6 of which the traumatic origin was doubtful concludes that anomalies in this region are frequent often ill shown by average routine X ray plates are not always properly interpreted and are apt to be called fractures.

More than that it is suggested that real fractures of the transverse processes may not improbably unite by fibrous union without persistent symptoms and be chanced on later.

There is no doubt that real fractures of the transverse processes of the vertebrae in the lumbar region do occur probably not very infrequently. How important they are does not yet appear nor will their importance be manifest until other series are studied and some of them carried on to investigation of end results.

*Subperitoneal or retroperitoneal cellulitis or infection* Acute abdominal pain in the right lower quadrant rapidly spreading and becoming general with tenderness rigidity



half an inch above the inguinal canal under the aponeurosis of the external oblique pierces the aponeurosis of the external oblique an inch and a half above the external inguinal ring becomes cutaneous and supplies the skin above the pubes below the level of the twelfth dorsal. It gives off branches to the transversalis oblique and pyramidalis muscles.

*Neuritis and neuralgia* Neuritis and neuralgia are differentiated clinically but most neuralgias are probably due to a mild peri-neuritis.

In neuralgia the pain is sharp shooting and paroxysmal limited to the course of a nerve and is made worse by peripheral irritation. In neuritis the pain is constant burning or boring and worse at night with tenderness over the course of the affected nerve and aggravated by pressure there may be trophic changes with anæsthesia paralysis or atrophy.

A localized neuritis or neuralgia of one or more of the nerves of the abdominal wall might be characterized by pain varying in intensity of boring or stabbing character along the course of the nerve and its distribution with local tenderness and pain on pressure or motion. Elevation of temperature is rare and constitutional symptoms slight. There may be anæsthesia tactile sensation lessened though pain sense increased paræsthesia with numbness tingling or formication atrophy or paralysis with absence exaggeration or diminution of reflexes.

Such disturbances if they exist in the nerves of the abdominal wall and there is reason to believe that they do have been given but little consideration and demand study because they have undoubtedly led to erroneous diagnosis. Such a group of symptoms with a crop of vesicles is classic in herpes zoster. Head and Campbell conclude that herpes zoster is a specific infective disease in which the virus has an affinity for the nervous system particularly the ganglia and considers the disease as an acute posterior polyomyelitis in contradistinction to acute anterior poliomyelitis. Rosenow concludes that this disease is due to a streptococcus having elective affinity for the ganglia and posterior roots.

Herpes zoster of the face and upper intercostals is recognized and comparatively frequent but of the lower intercostals and the first lumbar if as frequent is but rarely recognized. The location of the pain and symptoms often lead to a diagnosis of intra-abdominal disease and the hot applications which are frequently applied may cause one to misinterpret the presence of vesicles. Such cases have undoubtedly been operated upon for acute appendicitis. The occurrence of zoster of the viscera may no longer be questioned as such cases are cited in the literature and the knowledge of such a possibility adds greatly to the difficulties and uncertainties of proper interpretation of the significance of acute abdominal pain.

A local neuritis near the abdominal wall which if imitated in the nerves of the right iliac fossa would cause great confusion is the meralgia paræsthetica which is well recognized and a definite clinical entity. It was described first by Bernhardt in 1805. In 1900 Musser and Sailer collected 99 cases and W. J. Rutherford reports a dozen cases in the last ten years. The symptoms are caused by a mononeuritis of the external cutaneous nerve of the thigh (A branch of the second and third lumbar nerves). There is a local paræsthesia of which the cause is unknown and the treatment unsatisfactory.

Other forms of neuralgia or neuritis which lead one to admit the possibility of a local right side abdominal painful affection of the nerve are occipitocervical neuralgia with induration and tender spots. If such areas of induration occurred in the abdominal wall near McBurney's spot erroneous conclusions might be drawn.

Pain such as that of tic douloureux or intercostal neuralgia if occurring in the distribution of certain abdominal nerves might lead to unnecessary laparotomy. Migraine sciatica or lumbar neuralgia coccydynia pododynia and other similar affections if appearing in different locations might give rise to confusion.

*Wryosis and myalgia* The fact that localized pain tenderness and rigidity may be due to pathological conditions within the substance of the abdominal wall seems to

have been consistently overlooked. A myositis in a certain location in the abdominal wall if unrecognized might readily be confused with intra-abdominal lesions.

The myalgias rather loosely defined as painful affections of the voluntary muscle fascia or periosteum to which they are attached (many authorities claim it to be a neuralgia of the sensory nerves of the muscle) are recognized in certain anatomical locations as lumbago, torticollis, pleurodynia.

Pain is the prominent symptom. The constitutional symptoms are mild; there is no fever and no leucocytosis. An abdominal type of this condition is admitted but it has not been given due attention and if unrecognized would lead to confusion and error.

The headaches that are accompanied by areas of induration usually at the origin or insertion of muscles in the scalp and neck might well be studied more carefully and the occurrence of similar phenomena in the abdominal wall might clear up some of the uncertain cases of abdominal pain.

**Lead colic.** The colic of lead poisoning has frequently led to unnecessary laparotomy because of its very close simulation of intra-abdominal disease. The abdominal pain is general and associated with marked muscular rigidity, noteworthy in being relieved by pressure. Vomiting and constipation are present; the pulse is slow and of high tension with an absence of elevation of temperature. The blood count shows anemia with stippled red cells and usually no leucocytosis.

Characteristic Burton's lead line unfortunately is present in only half of the cases but if discovered the diagnosis is confirmed. A false lead line may be found on the gums of any person working in dirty metallic dusty surroundings. This may be removed by cleaning the mouth and teeth. The true lead line is not on the gum but is in the gum and in its incipency is not a line but a series of dots; the result of chemical changes between the lead and sulphur of decomposing particles of food and will not be removed by cleaning. It is best seen with the aid of a magnifying glass.

In securing the history it is well to remember that plumbism may occur in occupations other than that given as painter.

**Tabes Nuzum** has made a most important contribution to the literature of tabes in which he quotes from the classic description of this condition by Charcot as follows:

But of all the visceral symptoms which may display themselves from the period of lightning pains, one which is at once the most remarkable and the least known, if I mistake not, is that which I have proposed to designate by the name of gastric crises. Very often their real significance remaining misunderstood, they are the occasion of grave errors of diagnosis.

But it is time to tell you in what these gastric crises consist. Suddenly and generally at a period when a paroxysm of shooting pains has seized upon the extremities, the patient complains of pain which starting from the groins seems to ascend both sides of the abdomen and to become fixed in the epigastric region. At the same time the complaint of pains situated between the shoulders which radiate around the base of the trunk in a lightning-like manner. Then the pulsation of the heart commonly becomes violent and precipitated. Rapidity of the pulse without fever is in truth a very common incident. Almost incessant and extremely distressing vomiting is often associated with gastric crises. Food is first ejected, then a mucous, colorless liquid, sometimes mixed with bile or tinged with blood. An intense feeling of sickness and vertigo are superadded to the vomiting and cardiac pains. Many a time I have seen this symptom diverting the attention of the physician and causing him to misapprehend the real nature of the disorder. I also have several times fallen into the snare in other days.

The gastric crises of tabes has until very lately in the minds of many physicians been considered a rare, unusual and late manifestation of cerebrospinal syphilis.

That many cases of gastric crises have been mistaken for acute abdominal lesions has been more or less imperfectly realized but Nuzum's article entitled "Needless Surgical Operations from Failure to Recognize Tabes Dorsalis" is of great value in attracting attention to the frequency of the slipshod or careless methods taken to arrive at a diagno-

sis Nuzum collected and analyzed the records of 1000 cases of tabes treated in Cook County Hospital during the four years 1910-1915. In these 1000 cases 97 needless operations had been performed upon 87 patients.

In estimating the number of operations only those have been included in which the patients were told by the surgeon that nothing wrong was found and in which the old symptoms returned following the operation. Cases have been excluded when scars of previous operations were found in the epigastrium, kidney or appendix region with no record of what was found or done at the operation recorded on the history sheets or when this could not be learned from the surgeon.

The surgeon's diagnosis in these cases was as follows:

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The occurrence of real bona fide abdominal pathology in conjunction with tabes must not be lost sight of. Nuzum recognizes this fact and excludes such cases and reports a case of perforation of a duodenal ulcer in a tabetic that was discovered at autopsy by LeCount.

Just because a person has tabes it in no way eliminates the possibility of an acute abdominal emergency or any other type of an emergency and it is just such possibilities that make the personal equation of the diagnostician of so much importance. A study of the cerebrospinal fluid is of value as an increase in the cells is quite a constant finding even in the early stages. A positive Wassermann is of great value but is not conclusive as there is a percentage of error variously estimated from 1 per cent up. False positive may occur in cancer, tuberculosis, scarlet fever and Hodgkin's disease. 25 per cent to 30 per cent of luetic are negative in

tertiary stages as also are the so called parasyphilitics.

A provocative dose of antiluetic treatment will reduce this percentage of error materially. In all doubtful cases both the blood and the spinal fluid should be examined.

Cabot summarizes the matter by saying:

What we are learning in the last few years since lumbar puncture and Wassermann reactions in the blood and spinal fluid have become matters of routine in doubtful gastric cases is that any type of stomach trouble, acute or chronic, mild or severe, sharply painful or merely distressing may be due to cerebrospinal syphilis. Until within the last few years one was on the lookout if he were conscientious for so called gastric cases in tabes. What we have learned lately is (a) That we must suspect the possibility of tabes even when the pupils are normal and must investigate this possibility by means of spinal puncture. (b) that any sort of gastric abdominal pain or distress may be due to tabes.

I shall merely present Nuzum's conclusions which represent the consensus of opinion on the subject at this time and urge that this article be not only read but carefully studied by every one who presumes to perform laparotomy.

It is believed that the absolute amount of tabes included in the future more tabetic list spared useless surgical operations and more acute abdominal symptoms will be proved of spinal origin. Of 1000 tabetics 87 per cent have been subjected to laparotomy under mistaken diagnosis.

The crisis of tabes has largely influenced the surgeon's decision to operate. This statement is supported by the fact that 65 per cent of the 8 patients operated on presented crisis. In 17 per cent of these the crisis is the initial symptom of the disease.

3. Mistaken diagnosis and resultant operations occur chiefly through failure to examine the nervous system.

4. Gastric ulcer, gall bladder disease and appendicitis are the diagnoses most frequently made.

5. Tabetics subjected to several successive laparotomies have as a rule been operated on by as many different surgeons.

6. A history of paroxysms of vomiting, rheumatism, pyrexias, bladder disturbances or fracture without physical violence should excite interest to exclude tabes dorsalis.

The cytodiagnosis of the cerebrospinal fluid together with the Wassermann reaction with the spinal fluid are of inestimable value in doubtful cases

*Hysteria* with its protean manifestations may of course be mistaken for intra-abdominal lesions. Clusivohysterics so well known if transferred to the right iliac fossa would many times be operated upon with a diagnosis of appendicitis. Still there is no reason why the same severe pain may not occur in the abdomen instead of the head.

Such tender spots do occur in the hysterogenic points viz the breast trunk spine and upper and lower abdomen and it is the type of painful spot in the lower abdomen that has been responsible for the ovariotomy furor and now the appendectomy craze.

Tympanites or phantom tumor may likewise confuse the issue.

Careful history taking and complete examination with the discovery of anæsthetic areas or superficial tenderness greater than that elicited by deep pressure with an absence of temperature or leucocytosis will usually prevent error.

#### INTRAPERITONEAL LESIONS

Intraperitoneal lesions that may simulate surgical conditions may include cardiospasm cirrhosis of liver acute dilatation of stomach acute gastritis acute enteritis ptomaine poisoning typhoid fever angio-neurotic œdema gastroptosis mucous colitis chronic intestinal stasis salpingitis dysmenorrhœa pregnancy and others.

*Cardiospasm* It is but a comparatively few years since abdominal operations were performed for various conditions in which undetected and unsuspected cardiospasm was the real cause of the symptoms. Smithies reports 34 cases in but 5 of which had the possibility of cardiospasm been considered. A very careful history and examination will prevent such error.

*Cirrhosis of liver* Biliary or hypertrophic cirrhosis (Hanot) is characterized by jaundice an enlarged liver attacks of pain in the region of liver that may be severe and associated with nausea and vomiting possibly with slight fever and leucocytosis. The nega-

tive features are absence of ascites and dilatation of the blood vessels.

Because of the gastric attacks jaundice and enlargement in the region of the gall bladder this condition is not infrequently confused with cholecystitis.

Portal or atrophic cirrhosis (Laennec) is characterized by small contracted liver ascites and portal obstruction manifested by the caput medusæ hæmatemesis or melæna.

According to Rolleston and confirmed by Cabot acute symptomless hæmatemesis occurs in 20 per cent of gastric and duodenal ulcer and in 50 per cent of cirrhosis of liver.

Dyspepsia is a common symptom as is the hepatic facies viz eyes sunken conjunctiva watery nose and cheeks showing distended vessels and the complexion muddy and ichteric. Cerebral toxic symptoms may develop in time and are usually mistaken for uræmia. The ascites may lead to a diagnosis of tuberculosis of the peritoneum or malignancy. The disease is not rare.

The Tula Morrison omentopexy has not been accepted as superior to trapping and the establishment of Eck's fistula i.e. portocaval anastomosis has met with little favor since its first performance on man by Vidal in 1903.

Mayo states that his experience with splenectomy in cases of splenic anemia has been such as to encourage him to splenectomy in suitable cases of portal cirrhosis especially when the spleen is enlarged.

*Acute dilatation of the stomach* may be mistaken for peritonitis or ileus. Liparotomy is rarely indicated as gastric lavage will not only make the diagnosis but will serve as a very effectual therapeutic measure.

Acute indigestion is a term used rather loosely to indicate a condition in which the usual gastric symptoms present but this name can consistently be applied only to those in which the symptoms end by the emptying of the stomach.

In acute gastritis there may be temperature the usual absence of a leucocytosis will aid in differentiation. The abdominal pain may be intense and the attacks may be confused with cholecystitis or appendicitis. This differentiation may be at times extremely difficult.

Acute enteritis may be accompanied by abdominal pain but a temperature and leucocytosis is usually absent. The pain and tenderness are not localized.

In ptomaine poisoning there is no fever and no leucocytosis but there is abdominal pain, cold sweats, vomiting, continued diarrhoea and abnormal temperature.

A general proposition with infection there is fever but with poisoning there is no fever. Many gastritis, enteritis and ptomaine poisoning cases are gastric ulcer and all bladder or appendiceal infection.

An acute abdominal pain in the course of typhoid fever must always be given serious consideration. A coincident appendicitis is not rare. Perforation varies greatly in frequency but it has been estimated to be the cause of death in about 1 per cent of the fatalities. Perforation occurs in about 3 per cent of all cases, 80 per cent in the lower ileum and usually during the second and third week. Characteristic of perforation we find acute abdominal pain, rise of blood pressure, increase of leucocytosis. This may be a comparative increase and still be below normal, therefore the necessity of a close observation of the blood during the course of the disease.

With the symptom exploration is indicated. They may be found to be due to condition not remediable by operation but to wait more conclusive signs of peritonitis to wait a time at which treatment is usually unavailing.

In the literature we find many cases in which exploratory laparotomy was not followed by disastrous consequence. The diagnosis is most difficult because to quote Remen: "The unraveling of such a complication involves some of the prettiest diagnostic problems in acute abdominal surgery for it involves not merely the diagnosis of an acute abdominal condition *per se* but rather its diagnosis through the veil of signs and symptoms pertaining to another existent acute abdominal condition if we may class typhoid fever as such."

Typhoid fever must always be excluded in doubtful cases. Of great value is a history of temperature previous to the attack of pain.

The enlarged pericecal glands may simulate an appendiceal abscess and may give rise to pain and tenderness.

The leucopenia, the Widal and the other typical signs of typhoid or paratyphoid should be looked for.

**Angioneurotic edema.** The appearance of this disease in the skin has been well known since Quincke's description of it in 1881 at which time it was known by his name.

It is only recently that attention has been drawn to the fact that visceral occurrence of exudative phenomena similar to those observed upon the visible surfaces of the body, such as urticaria, erythema, purpura, all belong to the angioneurotic group, an angioneurosis that may give rise to abdominal pain which may cause even experienced observers to open the abdomen in the belief that some acute surgical pathology exists.

This condition may be due to chemical or toxic irritation to faulty metabolism or to anaphylaxis. William Osler has given this subject considerable attention and in a report of 29 cases cites Henoch's purpura in which intense agonizing attacks of colic have occurred with no cutaneous manifestations. The decrease in red cell and hemoglobin in these cases is most striking though there may be elevation of temperature and increase in leucocytosis. Because of the variability of the skin lesions and of their absence in some attacks patients rarely associate the skin conditions and the abdominal symptoms. In children particularly careful history taking should attempt to bring out previous attacks or lesions of the skin, inflammation of joints or abdominal colic or crises. In adults one is often struck by what may be called a neurotic tendency of the patient and one will note the indefiniteness of the nature of the abdominal pain which does not conform to the type found in the usual surgical lesions.

There is one type which lasts a few hours. This may be mistaken for gall stone colic or with hematemesis it may be confused with gastric or duodenal ulcer. Another type of longer duration is frequently associated with a swelling in the right iliac fossa and may suggest appendiceal abscess.

Such cases have been frequently operated

upon and a brawny induration of the entire cecum appendix and lower ileum is encountered. The appendix does not show sufficient change to be the primary cause of the condition. Harrington cites 1 case of this type. Osler 3, Riggs 4, and Mayo 3.

In cases seen for the first time in which there is large tumefaction of recent duration in the cecal region, severe pain without local peritonitis and with the patient in good general condition out of all proportion to the suspected lesion, a history of previous swelling should be carefully sought and if found watchful waiting is good surgery.

Crispin in an article entitled "Visceral Crises in Angioneurotic Edema" considers this subject *in extenso* and cites cases from the Mayo Clinic. His conclusions are as follows:

When a history of severe abdominal pain is given which does not conform to true surgical types careful inquiry should be made as to the presence at any time of urticaria, erythemas, purpura, and swellings of angioneurotic edema types.

A history of recurrent severe abdominal pains with constancy in the nature and duration of the attacks with skin manifestations of any of the exudative erythemic forms with or without noticeable association with the abdominal pains should excite suspicion as to the presence of crises of angioneurotic type.

A diagnosis of visceral crises of angioneurotic type should not be made until careful examination has excluded or made independent surgical causes. In this roentgenologic examination of the gastro-intestinal tract is valuable negative evidence. Syphilis and tuberculosis should be excluded.

The constancy in the recurring attacks of the pain not conforming to surgical types in patients who have had skin manifestations of the exudative erythema group and whose general condition does not account for the suffering they have had to bear will warrant a diagnosis of visceral angioneurotic edema.

Repeated or even single attacks of intestinal colic with tumefaction in which the patient's general condition is too good for the extent and severity of the trouble and in which history of the swellings can be obtained

may be of this type. To wait is good surgery. The rapid return to health is strongly suggestive of visceral angioneurosis.

Having determined the medical nature of these angioneurotic visceral crises we should endeavor to work out the sources of toxemia. There may be foci of pus in the upper respiratory tract and sinuses, bacterial absorption, idiosyncrasies to heat, cold, chemicals, parasites, carbohydrates or proteins that are the causes for anaphylaxis.

Removing the cause for anaphylaxis, whether it be idiosyncrasy in one patient for ice cream, some constituent such as cold bananas in another, alcohol in a third or any anaphylactic base or source of exogenous or endogenous irritation or poison may give the patient relief that the advised surgery would not have given him.

Appert from France likewise calls attention to this pseudoperitoneal syndrome due to urticaria, purpura or polymorphous erythema.

Since the work of Richert and others, Appert considers urticaria to be an anaphylactic phenomenon and that the cutaneous troubles are only the outward and visible manifestations of sudden changes in the blood called by Vidal a hemoclastic crisis.

**Visceroptosis.** The important phase of surgery in which visceroptosis has caused symptoms leading to unnecessary abdominal operations has been handled in a masterly fashion by Albert J. Walton. Thirteen cases were operated upon under the impression that the condition was an acute abdominal lesion—appendicitis; the remainder of the total 67 were mistaken for chronic abdominal disease—chronic appendicitis, gall bladder disease or gastric ulcer or cancer. Differing from appendicitis one finds a previous history of repeated attacks of a mild character and short duration. There may be a slight increase in temperature and slight rigidity. Walton well says: "If in doubt always better to diagnose appendicitis and operate."

Archibald MacLaren in a consideration of "Chronic Appendicitis and Visceroptosis" says: "The neurasthenic or visceroptosis case sometimes simulates the acute but usually is mistaken for chronic appendicitis."

*Constipation stasis* This subject despite its enormous literature is still unsettled and obscure. It is more intimately connected with the chronic than with the acute abdomen but as these cases are being operated upon and are being advised to undergo operations for acute abdominal conditions it must be mentioned at this time.

This error in diagnosis also occurs in other countries for example in London as shown by the report of Walton in Germany by that of Wilms in Amsterdam by that of Laewen in Norway by that of Widore. The latter reports 23 cases of intestinal stasis occurring in 1911 in 16 of which the family doctor had sent the patient to the hospital urging immediate operation but in all the trouble was merely intestinal stasis.

In view of the above citations from England Holland Germany Norway and I suppose a search would reveal similar reports from other countries it would seem that some reason for this diagnostic error must be looked for that is general geographically and that may be effective in all communities regardless of the type of education or the traditions and customs of the profession.

And such a cause will be found it seems in nothing more obscure than sheer laziness in which acceptable diagnoses are made without sufficient data the so called snap shot diagnosis which it seems is quite universal in international and not a national failing.

*Mucous colitis* Colicæ mucosa of Nothnagel is such a large and little understood subject that I shall not attempt to present a consideration of the topic but merely call to your attention the fact that this disease is quite common though frequently unrecognized that it is characterized by attacks of very severe abdominal pain with great tenderness that has many times been mistaken for intra-abdominal inflammation. The condition is associated with neurasthenia. The relation of one to the other like that of the chronic to the acute is not as yet determined.

In mucous colitis there are localized spots of cutaneous hyperæsthesia.

The areas of cutaneous tenderness pointed out by Head as corresponding to disease of internal organs have been verified in most

particulars by subsequent observers. Those which correspond to the intestines as far down as the upper part of the rectum are the ninth tenth eleventh and twelfth dorsal segments. Their respective positions are left costal margin above the center and one inch from the end of the rib just to the right of the umbilicus just above the left anterior superior spine and just above the middle of the right Poupart's ligament.

The presence of one of these spots last mentioned has been sufficient many times for the removal of an unoffending appendix. There is likewise a tenderness with rigidity on palpation along the course of the colon. There is in conjunction a gastroparesis enteroptosis is nephroptosis is a so called hirsutism enteroptosis. Constipation is usual though diarrhoea may alternate with constipation. At times usually before evacuation of the bowel there is a colic which may be very severe. The passage of thick glairy mucus in variable amounts is characteristic. The mucus may be rolled into worm like masses that may be looked upon by the patient as worms.

This condition is a neurosis and not an inflammation consequently there is usually an absence of leucocytes and temperature.

Van Norden and Nothnagel have described the condition and Henschell and Abraham have published a large monograph. Spitzig of Cleveland has considered the subject and Capperoni in a recent article dwells particularly upon the pseudo-appendicitis attacks that may occur in this condition.

This is a very obscure question and greatly in need of elucidation. Therefore it will not be considered further than merely to mention the fact that it is a frequent source of error in history examination and hurried diagnoses. Salpingitis may be confused with appendicitis but a vaginal examination with careful history will usually clear up the diagnosis.

The question of the advisability of delaying operative interferences in acute pelvic infections until the acute inflammation has subsided has it would seem been definitely settled by the observations of Simpson.

In but very rare instances is surgery indicated danger to life is slight the danger of

non operative treatment is largely one of continued morbidity and recurrent infections. A coincident acute appendicitis should of course be treated by accepted radical measures. Simple dysmenorrhea may be mistaken for acute abdominal inflammation. The history and close observation will prevent such confusion.

During the course of pregnancy there is sometimes a tendency to complain of pain and tenderness sometimes a severe colic in the right iliac fossa which has been responsible for operation with a diagnosis of appendicitis in which the findings did not coincide with the subjective symptoms.

An explanation has been offered by DeLee as follows. This pain is almost always in some relation to McBurney's point and is due to the dextrotorsion of the uterus throwing the right tube and ovary forward with a resultant compression of these delicate organs between the utero abdominal walls.

But whether or not this is the proper explanation the clinical fact is well worth remembering. The frequency of appendicitis in pregnancy has been variously estimated but I shall merely quote from two prominent obstetricians in a recent discussion. R. W. Holmes says "I wish to take issue with Dr. Beck in his statement that appendicitis in pregnancy is very common. It naturally falls out that the findings of the general surgeon on this question will give a higher proportion than would be the case of the obstetrician. I have repeatedly had women complaining of right sided pain *but that is not appendicitis* although I am sure many a pregnant woman has had her appendix removed hurriedly on account of such pain."

Dr. DeLee says "I am quite confident that many a so called appendicitis in pregnancy is merely a mild toxemia of pregnancy, the physiologic leucocytosis of pregnancy coupled with nausea. Epigastric or perhaps right sided pain misleads one into operating erroneously for an appendicitis which does not exist."

#### CONCLUSIONS

These remarks have been rather brief and sketchy in fact a mere running commentary upon a certain phase of surgery that is becoming more and more important. Other confusing conditions should have in all probability been included differential points may not have been sufficiently and properly emphasized but the effort has been to direct attention to the fact that these various conditions may simulate intra abdominal lesions some of which may have slipped your mind and that a diagnosis to be worthy of the name must be based upon a careful history of the case complete observation and accurate interpretation of the data so required.

As showing the importance of careful history taking Behlow says "From a careful history one can make a positive diagnosis of the primary or major conditions in 53 per cent of the cases."

The same care in taking a history will make possible a positive diagnosis of the secondary condition in 41 per cent of the cases.

If the above possibilities are kept in mind and each case given careful study our unsatisfactory results will decrease. This fact has been well recognized for centuries and has been consistently neglected as has been shown by DaCosta in an article on "Principles of Surgical Diagnosis" in which he quotes Benjamin Franklin "Want of care does more damage than want of knowledge" and Sir William Gull "We make more mistakes from not looking than from not knowing."

The coincidence of curable surgical lesions in individuals afflicted with non surgical and incurable disease must be recognized and the fact anticipated that the cure of a definite surgical disease in a chronic neurasthenic does not necessarily mean a cure of the neurosis. Or in the trite words of Deaver

"The abdomen will be found to be a veritable Pandora's box of troubles which do not however always fly away when the box is opened."



## LAPAROPLASTY BY A NEW METHOD

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THEPE is a vast number of people who have intra-abdominal organs are improperly housed on account of defect of the wall bounding and maintaining the cavity of the abdomen. The people await rational and generally applicable methods of reconstruction of the entire cavity of the body.

The abdomen is a walled space in which are housed various highly important structures. The spinal column supporting the head, neck and trunk passes through the posterior wall of the abdomen and forms a part of that wall. The muscle of the abdominal wall has the duty of maintaining the tension of the wall but this is only one of their important functions since they steady the spinal column and flex in the various directions the entire trunk. The wall may be encumbered with fat deposit and they may be weakened, stretched or rendered by wound, inflammation or necrosis, paralyzed. They change their place and the location of the intra-abdominal structure consequent upon or associated with them make necessary great effort on the part of the patient to do a method of relieving the abdomen so that the form and content of the abdomen

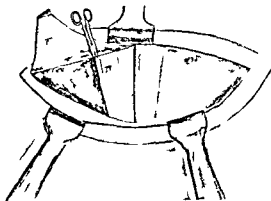
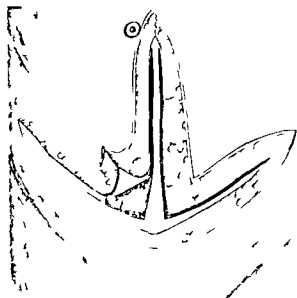
abdomen may be made the walls strengthened the defect made good the muscle given better line of action and the distance diminished between the origin and insertion of certain muscle while encumbering tissues are removed.

The simplest and most obvious laparoplasty is that of J. Clarence Webster who has operated in various series of cases of defective abdomen with and without diastasis of the recti. He removes by incision parallel to and including the median line from the umbilicus to the pubis a long strip of skin and subcutaneous fat then opening the sheath of the recti muscle he suture together the posterior plate of the sheath and separately the anterior plate. He has had excellent results the abdomen becoming narrower burdened with less fat and is more under the patient's control.

DePue's so proposed and carried out a laparoplasty and a laparoplasty. By the first term is meant the removal of redundant tissue from the abdominal wall. This is especially desirable when the patient is burdened with an enormous fat deposit. Far more important is his laparoplasty. His operation is as follows:

An incision is made across the abdomen from the tip of the eleventh rib of one side to the tip of the eleventh rib of the other side. From the extremity of this incision two incisions run out parallel to the point at the level of the umbilicus and one centimeter from the median line. From the upper end of the incision two outwards curved incisions are arranged in order to permit

the following



The following is a description of the incision for the new laparoplasty method. The incision is made from the tip of the eleventh rib of one side to the tip of the eleventh rib of the other side. From the extremity of this incision two incisions run out parallel to the point at the level of the umbilicus and one centimeter from the median line. From the upper end of the incision two outwards curved incisions are arranged in order to permit

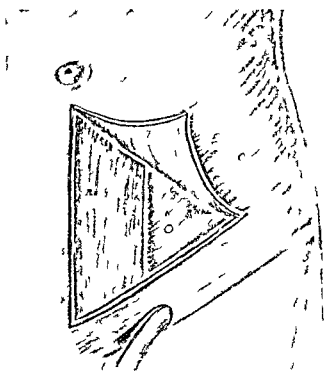


FIG. 3. The relation of the raised flap to the three muscle concerned

above the pubes. Then follows excision of the skin and connective tissue of the included area; the median line and the peritoneum back to the edges of the recti muscles. Three layers of sutures close the abdominal wall leaving a T shaped scar. Depage's operation has been frequently performed by others as well as by himself with reports of satisfaction.

Coffey's operation<sup>1</sup> consists in making an incision through the external oblique muscle parallel to Poupart's ligament, lifting up that muscle from its bed and carrying it over the outer part of the muscle to a lower level where it is stitched down. This very valuable operation is open to some objections which are the facts that for lesions involving the entire lower abdomen the retrenchment is local and may be inadequate and that the new abdominal muscle stress is laid upon the external oblique muscle alone and that too in a direction *perpendicular to the course of its fibers*.

The writer's laparoplasty for relaxed pouching or pendulous abdomens is as follows:

A median laparotomy wound is made in the lower abdomen and if necessary this may be extended well above the umbilicus which is best excised. A median hernia if present is managed by severing adhesions, replacing organs and clo-

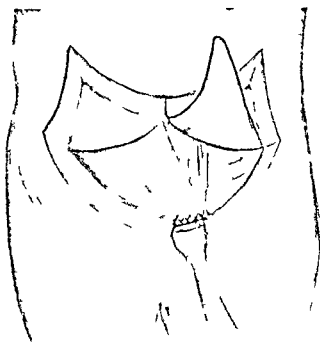


FIG. 4. The two abdominal wall flaps have been formed. The right hand flap has been carried across the median line and sutured nearer the level of the pubic bone. The flap for the left side is raised and beneath it are seen the bodies of the rectus and internal oblique muscles.

ing the retrenched peritoneum. The deeper wound is well protected by hot compresses. Laparoplasty is then carried out. From a point in the median line about one or two inches above the *symphysis pubis* incisions to the right and left are made starting at right angles to the median line but at the outer edge of the recti turning upward and outward in the direction of the fibers of the external oblique muscle and extending to a distance of six or more inches on each side splitting that muscle.

Next each of the triangular flaps thus produced of which the apices point downward is lifted carefully by separating the external oblique muscles (bearing their aponeuroses) up to the recti from the underlying internal oblique muscles. Then the anterior plates of the rectus sheaths are dissected up from the muscle bodies. These powerful connective tissue membranes lifted off from the bodies of the muscles leave the recti bodies in their normal beds. The raised rectus sheath flaps are now in continuity with the bodies and aponeuroses of the external oblique muscles. The effect of this work is to provide us with two triangular flaps pointing toward the pubes and consisting of parts of the sheaths of the recti and a large part of the external oblique muscles.

The next step is the crossing and reattachment



part of the trunk while the viscera were obviously held better in position

The nerve and blood supply of the tissues involved are not compromised by the incision recommended and careful attention to strictest asepsis should yield primary healing

The operation is recommended for plastic purposes (1) where as in military practice or in

case of sloughing inflammations or of neoplasms requiring excision loss of tissue has occurred (2) where hernias through the anteromedian structures are too extensive for simple plastics and (3) where relaxation due to fat deposits to lordosis to paresis etc has resulted in pendulous abdomens causing weakness inconvenience or interference with the function of the viscera

## ACUTE APPENDICITIS COMPLICATING EPIDEMIC INFLUENZA

### WITH REPORT OF EIGHT CASES<sup>1</sup>

BY MOSES BEHREND M D PHILADELPHIA

THE recent epidemic of influenza accompanied often with its most lethal complication pneumonia has furnished many occasions for the physician to make a differential diagnosis of a chest or abdominal condition. It is a well known fact that the referred pain of a right sided pneumonia often simulates the pain of an acute appendicitis. Many mistakes have been made in the past and many no doubt will continue to be made on account of the intimate relation of the nerve distribution covering the lower part of chest and abdomen. Numerous cases of pneumonia have been operated on in the past for pneumonia and vice versa cases of appendicitis have been treated for pneumonia with disastrous results in the majority of cases. In patients in whom the two cannot be separated it is better to operate with the aid of nitrous oxide gas and oxygen anæsthesia. In case a mistake has been made the course of the pneumonia in my experience has not been altered. All the cases pursued their natural course and ended in resolution.

Close inspection without the aid of any other physical signs will often make the diagnosis. Other signs are not of much value because early in pneumonia practically nothing is elicited on auscultation and percussion. The one sign which more than any other differentiates pneumonia from appendicitis is rapid breathing and plugging of the alæ of the nose. These signs are absent in acute appendicitis.

During and after the epidemic of 1888 and

later also in the milder epidemics many cases of appendicitis were reported. It has been a constant observation of physicians that appendicitis occurs in increased numbers after epidemics of influenza. The period of time between cause and effect varies. Many cases have been reported during the height of an epidemic but most of the cases of appendicitis occur some time after the patient is well. In 1888 several cases with pain in the right iliac region were diagnosed typhlitis. These cases were probably appendicitis.

Leichtenstern believes we are not dealing with acute appendicitis but rather with a typhlitis that exceptional cases of true appendicitis may occur especially when the Pfeiffer bacillus has been isolated that coincidental appendicitis when it does occur simply accompanies an attack of influenza. In only one of the eight cases observed by me was there any history of several previous attacks of appendicitis. Nor can I subscribe to the theory of typhlitis advanced by this author. Such cases were primarily appendicitis the inflammation spreading to the cæcum by continuity.

About ten years after the epidemic of 1888 when appendicitis was better understood as a distinct entity several cases were reported.

Merklin reported three cases which were not operated upon. One of the cases however discharged the abscess per rectum.

In 1901 Charpentier observed 5 cases of appendicitis in an epidemic of grip that

affected a regiment of soldiers in France in 1809. These cases were not operated upon and recovered. In only one case was there a previous history of appendicitis.

Frankel believes there is a causal relation between influenza and appendicitis. He states that appendicitis has become very common since the great epidemic of influenza in 1888. Some of his cases occurred in two to three weeks, others in as many months after influenza. Again he has seen cases simultaneously in the same family, a condition observed by other physicians. He also believes that in influenza appendicitis is often simulated, a pseudo-appendicitis.

Jolaguer has noted case of appendicitis in the course of influenza as has also Gaisant who goes so far as to state that grip is the main cause of appendicitis. He bases his opinion on the fact that there has been a large increase in the number of cases of appendicitis since the last great epidemic and that there is a recrudescence of appendicitis after each annual epidemic of influenza.

Weitlaner found in his cases now and then Pfeiffer bacillus influenzae but the pneumococcus influenzae predominated in the locality under his observation in 1909. Curdman quoted by Weitlaner confirms this statement. Weitlaner believes that a pneumococcus influenzae associated with a pneumococcus inguina forms the basis of a series of cases of appendicitis. He states that the pneumococcus had been found in the appendix and peritoneum by a series of investigators. He quotes especially Jensen who found pneumococci in the circulating blood in ten cases of appendicitis. Jensen himself found the pneumococcus in appendicitis in 6 cases, never however in pure culture, as had been found by Krogius in one case. Weitlaner is a firm believer in the infection of the appendix by the hematogenous route at least so far as the pneumococcus influenzae is concerned.

The occurrence of appendicitis in influenza is not mentioned at all by Althous in his fine treatise on the subject of influenza.

The writer has seen in all 8 cases of acute appendicitis complicating influenza. Seven of these were seen in consultation with other physicians. Three were operated on and found to be pus cases. Not any of these gave a previous history of appendicitis. In one the appendix ruptured while in the other two pus was contained in the appendix. All the cases recovered. The other five cases were not operated upon because it was feared that the prevalence of rales in the lungs would eventually result in pneumonia. This may seem contradictory to the statement made earlier in this paper but the wide diffusion of moist rales in the lung reminded one more of an extensive oedema than a characteristic pneumonia. On account of the wet lung the administration of an anæsthetic was feared.

Of these cases six were adults and two were children. All were taken sick during the height of the epidemic and had been in bed on an average of four days before the symptoms of appendicitis developed. In those not operated on the symptoms gradually subsided.

It will be interesting now to observe whether there will be an appreciable increase in the number of cases of appendicitis following the recent virulent form of epidemic influenza.

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## PRIMARY SUTURE OF WAR WOUNDS

By GEORGES GROSS, NANCY, FRANCE

(Graduat Prof so fth Md Lt iversity fN cy C lt S g t tl Fifth Army

PRIMARY suture of war wounds is certainly one of the burning questions of the day and quite justly so. At the outbreak of the war the theory of expectant treatment was the accepted rule. Those of us who had the greatest number of consecutive cases to deal with saw almost at once that in many of the wounded fatal accidents would sometimes occur. The practice of large open incisions systematically made and followed by rigorous drainage which I was one of the first to advocate<sup>1</sup> was the next step as opposed to the wait and see policy. This practice had proved its value but however excellent it may have been it certainly had its disadvantages. War wounds which are infected remain so after wide incisions are made even when they are followed by irrigation with antiseptics let them be what they may (ether peroxide of hydrogen Dakin solution). From our desire to improve the results obtained by disinfection with antiseptics has been evolved mechanical disinfection. At first efforts were made to obtain mechanical disinfection by scrubbing and brushing the wounds later by *lepluchage* or the cutting away of all infected tissue a procedure which is really better named excision for it is by wide excision that one must remove all bruised infected and dead tissue together with the projectile and all dirty extraneous material. In spite of excellent technique a certain number of wounds widely opened would suppurate for a long time either from the persistence of the primary infection or from secondary infection. Others equally carefully excised would clear up so rapidly and perfectly that one was tempted to believe in the possibilities of primary suture. The results obtained were often favorable but it is true that there was a certain number of failures even accidents which caused many to regard primary suture in most cases as an exceptional method of treatment and in others

a dangerous procedure. As regards myself I was an enthusiastic advocate of it since my colleague Ioubot showed that after scrupulous disinfection of the fractured bone surfaces an open joint could be completely closed and in nearly every case union by first intention was easily obtained.

The well known treatise by Ioubot has certainly had a great deal to do with the triumph of this method. During the summer of 1915 with the army before Verdun then afterward on the Somme primary suture began to have numerous advocates. Since June Houdard and myself<sup>2</sup> used with almost constant success the suturing of cerebrocranial wounds. Wounds of the soft parts even in the presence of fractures were also sutured during this period. Gregoire and many surgeons at the front hospitals believed and rightly that primary suture would be the coming method.

What is essential in deciding as to whether primary suture should be used in treating war wounds (1) the time that has elapsed between the receipt of injury and the period of operation (2) the anatomical possibility of making a complete and perfect removal of all damaged and crushed tissue and of extracting the projectile (3) clinical experience which would enable the surgeon to decide from the general aspect of the wound whether reunion would be successful.

When for one reason or another one has not dared to do a primary suture he could at the end of 15 or 20 days when the wounded man has become febrile and the wound has a clean look perform secondary suture. Secondary suture which can be carried out very well as I have demonstrated on a wound treated with aseptic dressings is generally followed by a course of treatment with the Dakin solution according to Carrel's tech-

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nique In order to determine when it is possible to perform secondary suture Carrel and after him Depage made bacterial counts of the wound discharge During treatment of the wound it was found that the number of bacteria gradually decreased and finally assumed negligible proportion Only then was secondary suture done This technique marks the appearance of bacteriological control in the treatment of war wound

Primary suture the ideal method of treatment of war wounds reached this point but did not gather many disciples in spite of its evident advantages when Tisser in the course of investigations begun at the end of 1917 in Flanders and published in 1918<sup>1</sup> discovered that one never had ever infection in a war wound (particularly gas gangrene) when in the wound one could not demonstrate the presence of an anaerobic and aerobic infection The nature alone of the germ living in a wound is important Tisser claims their number give one no useful information The works of Tisser can be summed up as follow Each war wound contains a peculiar microbial flora of its own on which depend its future development The bacterial growth varies it differs not only in different wounded men but even in different wound of the same individual Each microbe growing in a wound follows its own evolution and this process never varies The microbe multiplies for a period then the number remain constant then decreases more or less rapidly and at last disappears according to the power of resistance of the body to infection

Infection of wounds is sometimes primary sometimes secondary In war time as a wounded man passes through several hands in the course of his evacuation it is difficult not only to control but also not to increase the primary infection In every wound left open and uncovered the number of new bacterial infections cannot help but increase

Infection of war wounds usually pursues a purulent course of a type caused by the presence of quantities of putrefactive anaerobic organisms Two conditions are necessary to cause these anaerobes to flourish in living

tissue (1) the presence of tissue either bruised or deprived of its blood supply (2) the presence of one or several species of aerobic organisms

The rate of tissue destruction by anaerobic infection (gangrene) depends on the kind of aerobic with which it is associated and which seems to start the ball rolling Thus with the ordinary saprophytes only slightly virulent the anaerobic pus formation remains local in conjunction with the staphylococcus pyogenus it extends slowly whereas with the true streptococcus it spreads rapidly even attaining a fulminating type

Infection of war wounds may also become of a purulent type when the wound has not become infected by anaerobes or when these bacteria are not able to develop Under the conditions the type of aerobic microbe gives a special character to the wound With the ordinary saprophyte there is hardly any reaction with the staphylococcus local reaction more or less marked with the streptococcus there is at the same time a local and general reaction It is in these latter cases that one meets those long standing suppurations metastatic abscess formations bone lesions following fibrile crises with marked temperature oscillations and the slow cachexia which wears out the wounded man

In these two kinds of wound infections putrefactive or purulent it is necessary to establish the nature of the aerobic infection present in order to form a prognosis In serious cases it is always the streptococcus that is present

The following rules may be deduced from these investigations

1 Try as a matter of course primary suture if removal of the foreign body and excision of dead tissue is possible Establish at the same time the nature of the aerobic germ in the primary discharge in order to confirm your method of procedure If the staphylococcus is present keep close watch of the wound for fear of the appearance of a slow form of pus formation which it will be easy to check but which will not appear if the original dissection has been well done A little pus may collect necessitating the removal of a stitch or two If one finds the streptococcus

remove the stitches at once and by widely opening the wound combat the further spread of the infection. Anaerobic growth hardly ever takes place before 30 hours. As you can secure a bacteriological report about 6 hours after culture in ordinary broth there is no reason to fear that you will be too late in opening up the wound.

When primary suture has not been done you must as quickly as possible perform secondary suture being guided only by the nature of the aerobic infection. Here also you should take no notice of the presence of anaerobes. Their decrease begins about the third day and their development becomes impossible on the appearance of the phagocytes.

If the common saprophyte is found the wound must be sutured the second or third day. Results are always favorable. If the staphylococcus is present one must wait for its decrease between the fifth and eighth days. If the streptococcus is present one must wait for the period of spontaneous isolation of the organism. This is shown by a fall in temperature which usually commences about the twenty first day but sometimes earlier. The temperature remains down only when the wounded man becomes a mere germ carrier without general reaction or better still when the streptococcus has definitely disappeared.

The practice of primary suture and early secondary suture (delayed primary suture) is thus built on definite exact scientific lines which are founded entirely on Tissier's researches. It is only necessary to know the nature of the bacteriological infection of the different types of infection the streptococcus alone contra indicates primary suture of war wounds.

Since June 1917 my collaborators and myself in the Twelfth Mobile Surgical Ambulance have depended on bacteriological reports. Our results were presented in two lengthy communications before the *Société de Chirurgie*.<sup>1</sup> These results were such that they permit me to confirm the soundness of the theory of Tissier and to sum up thus. Every

war wound in which streptococcus is not present ought to be closed. The results may be summed up as follows: 78.3 per cent of wounds met with were sutured of the sutured wounds 88.8 per cent healed by first intention.

Several points should be studied in turn in order to understand the technique of primary suture as it is practised. They are the following:

1. How do the sutured wounds progress?

How do we know whether a war wound contains streptococcus (bacteriological technique)?

3. What surgical technique is to be followed to obtain constant results?

4. When must the suturing be done?

5. Its advantages.

*How do the sutured wounds progress?* Three things may happen. The wound may heal by first intention as in the ordinary aseptic operation slight redness may appear a stitch may cut out or other insignificant thing happen to disturb the wound course but regardless of this healing finally takes place. Or again certain symptoms appear or bacteriological information is obtained which causes one to reopen the wound.

Sutured wounds may heal by first intention and this is the result in by far the greatest number of cases. 88.8 per cent was the result obtained in my ambulance. The stitches are removed about the tenth day and the scar is perfect.

Certain facts strike one in dealing with these wounds the absence of pain being the most noticeable. Wounded men with unsutured wounds always suffer. Those with sutured wounds on the contrary never complain and certainly not after the second day just as is the case with patients operated on in civil practice. In this manner they differ very greatly from the cases with wounds which have not been sutured. After the second day in the sutured case the patient even if suffering from multiple wounds or fractures feels perfectly well and begins to get up if he is wounded only in the upper arm. The facial expression is good the color normal the tongue clean the pulse regular and of good



volume. The temperature in most cases is slightly above normal but often normal. In the majority of cases it varies between 37 and 38 and falls to 37 rapidly. In some cases however it remains high for some time and rises above 38 for 4 or 5 days. Examination of the temperature chart is the only check necessary to keep on these patient who however badly wounded have the appearance of slightly wounded cases.

The dressing done at the operation is not removed before the tenth day. It is necessary to make sure that the suturing and the skin around look perfectly normal. Healing is perfect and when the stitches are removed we find perfect apposition of the edges of the wound. A simple protective dressing is applied and as in all aseptic operations the wounds cicatrize under the two dressings and the patients are evacuated cured on the fifteenth and twentieth days. It must not be supposed that this healing will succeed only in minor wounds and that in them alone will one see healing take place with such ease. I have sewed up and have seen closed wounds of the soft parts which were certainly 5 centimeters in length and of a really serious nature—such as amputations for crushes, resections of the thigh, arm, torn wounds of the buttock with the foreign body against the ischium, foreign bodies in the neck, various ligatures of the large vessels, wounds of large extent and very foul, dating back 24 hours or more. In a large number of cases the injuries consisted of fractures of which several were badly smashed up. In a number of these fractures (300) one sees better than in a sequence of ordinary wounds the splendid results obtained by primary suture. Such a large series of cases has never before been published.

*Primary sutured wounds running an abnormal course.* Side by side with wounds healing by first intention one finds others pursuing a less normal course which in spite of setbacks end by healing in some cases normally and in others after a slight infection of limited amount. This fact has been evolved by careful attention to the temperature chart. The general condition of the patient remains good, the facial expression bright and the wounded man has a good appetite and is

cheerful. The pulse is good in volume and tension and in no case does it become small and rapid. Attentive study of the temperature chart alone gives one warning of coming events.

In the first type the temperature which during some days remained elevated to 38 or even 39 at night falls slowly in 8 or 10 days or better still with only a slight rise toward the fifth or sixth day falling slowly afterward. I have already stated these facts in relation to joint wounds.<sup>1</sup> If the closed wound is examined there is found a little localized redness around one or several stitches. The region is slightly tense and swollen but the findings remain quite local and soon little points of pus appear at the stitch holes. The whole condition subsides and the wound remains closed and the healing is but slightly delayed by this small superficial infection.

In the second type the symptoms are not so mild, they present a more severe picture. On the one hand the temperature on the day of operation rises to 39 or 40, remaining there two or three days and then falling suddenly to 37, there remains or again mounts to 39 or 40, falls to 37 not so rapidly but in five or six days by degrees. If however during this rise in temperature the dressing is removed the wound is usually found to be swollen and painful but the skin remains normal in color. If between two horsehair sutures the point of a Kocher forceps is inserted and the blades are slowly opened a little blood stained fluid containing a few gas bubbles escapes. The healing will be none the worse for this, even if from a sense of prudence one has thought it wise to remove a stitch. The small wound resulting from this useless opening prolongs the healing time a few days. These infections however rarely occur (in about 5 or 10 per cent of cases).

In other cases not only the vicinity of the sutures is a little distended and swollen but there appears a cherry red color extending some distance giving an appearance which is disquieting to any one not acquainted with the course in such cases. The erythematous flush spreads toward the extremities of the limb and is sometimes accompanied by the presence of

gas under the sutures giving a resonant note on percussion an unpleasant smell and a blood stained discharge which escapes between the stitches. But the wound has this characteristic appearance. Locally the erythematous flush is more cherry colored at the beginning than that of a gas gangrene and in general there is complete discord between the temperature on the one hand and the pulse and general condition of the patient on the other. Both remain excellent and this at once attracts the attention of the most experienced observer. In spite of these symptoms it remains none the less true that only bacteriological examination giving assurance that the wound does not contain the streptococcus prevents the surgeon who understands the symptoms from opening up the wound. These cases are quite rare in my experience there were not more than 1/18 per cent. However following these acute symptoms we some times see develop a little suppuration and a gas abscess forms and must be opened up.

*Voluntary opening up of wounds already sutured.* This is necessary in a special kind of wound in which bacteriological examination has disclosed the presence of the streptococcus. Whenever the streptococcus has been definitely found the wound must be opened up. Some times this is done at once after examination. In other cases there will be no symptoms which indicate what procedure to follow and the bacteriological report alone will be the guide. In such cases the general condition of the patient is good the temperature is only slightly raised, and the skin adjoining the wound has a normal appearance for the infection has as yet had no time to develop. Some of these wounds which are not opened continue to heal without any great disturbance and untoward incident and the skin keeps its color and texture. Toward the tenth day the stitches are taken out. Often the thickened edges of the wound gape a little and when the stitches are removed the wound opens spontaneously like a book. This is a sure sign of the presence of the streptococcus. It is then practically certain that if the wound is not voluntarily opened up it will open itself and it is only running risks to leave it sutured. Usually at the end of a few hours the wounded

man is suffering and complains. His general condition is quite different from that of previously described cases. His expression is drawn his pulse more rapid. The skin of the injured region is port wine red in color with marbling (motley lines) spreading far and wide and gas escaping from the wound. This is the local gangrenous form. Destruction of the tissue has already spread though the wound has been widely excised. Can we assume that the suturing has caused this serious condition? I think not. This development well known to all surgeons at the front is the same in wounds opened widely drained and left open. The suturing too may have been done only a few hours but the wound so badly infected at the time of treatment has widely opened. In short these fatal accidents ought to be the exception. I have seen but three such accidents in 759 sutured wounds or 0.39 per cent. Men with such wounds die in the same way as do the cases with acute toxæmia even before suturing can be done after an amputation and the same symptoms and the same temperature curve are present. No surgical intervention can save them.<sup>1</sup> We are familiar with this form of virulent toxæmia which leads to a rapid and fatal termination sometimes almost without development of gangrene and against which we are powerless.<sup>2</sup>

The wounded infected by the streptococcus present a typical picture. Their facial expression is the same as that in long standing seriously wounded and infected cases. They are pale the pulse is rapid the temperature fluctuating and the appetite poor. The look of the ward where they are isolated is markedly different from the other wards. This however is to be expected. Since infection due to the streptococcus is all we have to fear the wounded suffering with it should be isolated. It is strange that all surgeons still will not adopt this precaution although they isolate systematically and have for a long time each patient suffering with erysipelas and the erysipelatous streptococcus is certainly much

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less virulent than the streptococcus of war wounds

Bacteriological reports upon which some light has been thrown by Lissier easily explain the incidents which may happen in primary sutures of war wounds. His investigations prove that the incidents come from a special pre-existing germ. There are exacerbation which can originate only in the wound incompletely cleared of dead tissue.

*How do we know whether a war wound contains the streptococcus?* Primary suture of war wounds is based entirely upon the works of Lissier. It can be carried out systematically under bacteriological control. In my mind the bacteriologist is as indispensable to the surgeon as the radiologist. Besides the report from the laboratory must be returned quickly so that the sutures can be taken from the wound a few hours after they are put in if the cultures have revealed the presence of the streptococcus.

The technique is the simplest. In the first place as smears of pus and serum do not give exact indications one should proceed only after cultural examination. In fact the only danger to be feared in primary suture of war wounds is the appearance of a putrid infection which makes rapid progress. The cause of the terrible forms of infection is always an association of anaerobes and streptococci. It is quite necessary to inform the surgeon as quickly as possible of the presence or absence of the streptococcus. The only medium in which the streptococcus grows quickly is a liquid medium at 37°C. Within 5 or 6 hours there appears in the liquid lumps of long rolled up and absolutely characteristic chains.

Bacteriological specimen should be liberal and taken from all parts of the wound chiefly from the deep parts near the bone when it is injured. It is best to use a pipette in order to collect a great deal of serum and particularly of blood as often as it is possible. The most convenient time for collecting the germs from a wound is between the tenth and eighteenth hours after the soldier is wounded. Sooner the bacteriological specimen would probably not contain all the different kinds of germs and later the considerable and predominant

growth of anaerobes may hide the presence of aerobes particularly of the streptococcus.

The inoculations should be made in broth upon slanted agar with litmus and lactose and into deep agar of Veillon. Common broth is sufficient in the majority of cases nevertheless in order to facilitate the growth of streptococcus it has been proposed that Saccap's medium (that is albumin of egg with soda—Paymond) or other albuminous medium such as ascites be added. Weinsenbach advocates water with peptone glucose and alkaline egg albumin and Boveri a bone maceration with peptone.

These proceedings make it possible to obtain results most quickly if the wound contains the streptococcus—between the fourth and sixth hours the streptococcus with its classical characteristics is more clearly demonstrated within the following hours. The broth remains clear but a deposit is seen which by shaking changes into characteristic clots. When one has collected some blood there is hemolysis a very important phenomenon to establish. One can see much the same it is true among cultures of bacillus mesentericus or anaerobes but in these cases the appearance of the cultures is different: there are no clots and the microscope permits a solution of the question. The slanted agar with litmus and lactose if turned red is covered with tiny colonies more or less transparent fine rather equally strewn upon the surface and generally separated from each other.

After staining one sees some gram positive cocci in chains of at least twenty cocci. As these are short in solid media one will search for them preferably in liquid media (broth clots and water of condensation from slanted agar at the bottom of the test tubes) where they are most often typical very long particularly rolled up and entangled. Short chains might be enterococcus but generally this germ is more polymorphous it does not produce hemolysis and uniformly clouds the medium with a mucoid thick deposit which rises up like a gumlet when one shakes the tube.

Within agar of Veillon one will find the streptococcus very frequently it grows easily in the presence of oxygen but particularly

one will find the bacillus perfringens which is one of the first to appear and also the most frequent

The streptococcus is rather less frequent in recent war wounds (10 to 15 per cent) and the association of the streptococcus and the anaerobes even less frequent (6 to 8 per cent). It is important to bear these facts in mind for during the periods of intense work it is possible to examine only the wounds which are more likely to contain these infectious germs i. e. deep ragged wounds among thick masses of muscular tissue. Afterward during more calm periods systematic examinations can be made of all wounds.

*What technique should be followed to obtain constant results?* In most cases well done *excise*. How is excision of war wounds best done? First the entire wound of entrance should be thoroughly excised. Then for a seton (the projectile having crossed the whole part of the limb) the cutting away of both orifices. The first is easy to do with an elliptical incision one circumscribes the orifice sufficiently enlarging the incision so that later it will be possible to excise the deep part of the passage. The uncovered aponeurosis is laid open. By following the passage of the projectile a broad excision of the muscular tissue which limits it can be done.

Exploration of the passage should be avoided whenever possible. Even with a smooth instrument the end may penetrate the neighboring tissues and infect them. It is preferable to explore with the finger which acts as a guide in following the tract. Usually this questionable practice is useless for the direction of the passage can be demonstrated by radiology.

Incision preceding suture must be done with full knowledge of the conditions present. All blind exploration at the end of the finger must be avoided. When the tract is outlined and after the projectile has been extracted one practices wide excision layer by layer. The technique called *epiluchage* is certainly inadequate the word is badly selected it instils in the surgeon's mind ideas of false security. With *epiluchage* primary suture does not bring success but disastres. One must practice wide *excise* of the devitalized tissues.

It is quite useless in order to determine the amount of tissue to be excised to color the wound with methylen blue the experienced surgeon will stop the excision in time that is to say he will cease to excise when he reaches muscular fiber which is not deprived of its blood which has not the dark port wine color or has not the well known soft consistency in other words when the tissue has become firm is contractile and is red in color in short when it bleeds.

Three typical procedures may be employed  
1. Opening and laying open of a seton (the projectile having crossed through all the soft tissue) or of a wound with projectile included under the skin. One cleaves the tract if it is not too deep then extirpates it completely *en bloc*.

Lamprapion *en bloc* of the entire wound when it is superficial or even when deep and widely laid open.

Usually the lesion is deep and the incision must be conical the top of the cone being beyond the projectile or upon the fracture. This excision systematically made with scissors takes away layers of devitalized tissues. It must be made thoroughly carefully systematically reaching the seat of injury where the projectile is lodged. For a deep seton (in the upper part of the thigh for instance) one must do a double conical excision the tops of which will join. Bony lesions neither can nor must cause a total *excise*. In a fracture one must always be satisfied to remove carefully all the free splinters not adherent and sometimes with one stroke of the bone forceps to make regular the sharp fragments. One must always leave the adherent splinters which are so useful. I plainly condemn removing large pieces of bone a procedure I have alas so often seen practiced. TISSOT showed that the cutting away of free splinters is sufficient. Clinically we have already learned that the bones become infected slowly through the soft parts and consequently operations upon bones must not always be extensive ones.

If the projectile is situated within a diaphysis or an epiphysis the tract and chamber shall be carefully hollowed out enlarged and if possible laid flat. The cavity should be

touched with iodoform ether. It can be filled in different ways. No one among my collaborators ever tried plastic pastes, but one of them (Houlard) used with good results in four cases fat graft taken from the buttock.

In the treatment of injured joints as often as it is anatomically possible the ideal method is the operation of Joubert. I firmly recommend it as the best method in the majority of lesions, typical or atypical, resection according to the extent of the lesion. No matter what the anatomical lesion, how thoroughly excision has been done it will not be complete naturally without the extraction of the projectile and bits of clothing. The useful anti-septics are either for flesh wound (soft part) (imbredanne) and iodoform ether for bone injury. The technique of the suture itself remains to be described. Sometime it is useful to suture the deep muscular layer with catgut. I do not like this method as I have noticed that the catgut suture easily becomes infected. Two conditions are most important in order to obtain a good suture: perfect hemostasis and care not to leave a dead piece under the sutured skin. One can perform a good closure with rolled up gauze and three or four bronze wire. After the bronze wire are carefully placed approximation of the skin edges is brought about with horsehair. Then there is placed over the suture line a pledget of rolled up gauze (called in French a *bourdonnet*) and the bronze wires are tightened over it. The *bourdonnet* when it is not soaked by oozing is taken off only when the cutaneous horsehair suture is removed. It is preferable to remove the horsehair suture slowly about the tenth or twelfth day for the process of healing of the war wound is slower than that of septic wounds in civil practice.

*When should the suturing be done?* In any case where no streptococcus is found in the wound and when there exists no anatomic or pathological contra-indication. Practically every wound may be sutured upon arrival of the wounded man, but one must always reopen the wound in which within 6 hours the bacteriologist has found the presence of the streptococcus.

Does the time elapd between the receipt

of the wound and the arrival at the hospital contra-indicate operation? I do not think so. Certainly the longer the interval that has elapsed the more infection could develop, but with thorough excision I have myself sutured and have seen sutured wound which had been received 24 and more hours before and correct and complete reunion resulted. It seems to me one can find in these facts a greater proof that in deciding upon the technique to follow one need bear in mind only the type of infectious germ found in the wound, a wound containing the streptococcus must not be sutured after a few hours, those containing only common saprophytes can be sutured after 4 hours or more. Where suturing is contra-indicated the wound should be left open. In my mind suture is contra-indicated in the following cases:

1. In multiple wound when the patient is suffering from shock, yet in condition to be operated upon, but where it is necessary to do the operation very quickly.

In deep wound the complete excision of which is impossible, wounds which appear to be badly infected, very old wound or wound communicating with septic cavity and wound with increasing gaseous gangrene.

3. In wound with projectiles remain in them.

4. In wound with great vascular lesion.

5. In wounds producing extensive injury to the skin.

6. In wound which do not require suturing (enucleation of the eye).

Most of these contra-indications do not need explanation. Certainly suture lengthens the time of operation. When it is necessary to operate quickly upon the multiwounded man who is in a serious general condition it is preferable to save his life. The final result will be a little less brilliant. However one can operate and suture the multiwounded man if he is not suffering from shock. In the case suffering from shock one should be satisfied to suture the principal lesion (joints or bone) only incising and draining, or even neglecting the less important lesion which will be treated later. The correct and complete excision of infected and devitalized tissue is the principal requisite for a successful primary

suture. When the operator cannot do this he must leave the wound open. When the projectile has not been extracted the same contraindication exists if the projectile is small (green per) or if it is extremely small one can suture leaving within the tissues one or several projectiles. I have often done this and have seen it done. I do not think one can advise against suturing wounds in a period of intense activity in my ambulance three operators sutured 49 gravely wounded men within 4 hours.

Nevertheless when a considerable number of wounded men overflow the ambulance and when one has not sufficient room for keeping all the wounded men it might be well not to perform primary suture but follow Pierre Duval's technique<sup>1</sup> i.e. delayed primary suture. At first the wound is widely opened and the excision is done. Then the wounded man is evacuated to another sanitary center situated at the base (*Zone des Elapes*) where the wound can be sutured after two or three days. According to the author's advice delayed primary suture is founded also upon the works of Tissier. In these cases it remains only a necessity primary suture is preferable. Certainly delayed primary suture has some disadvantages the principal one being the necessity of giving two anesthetics and of doing two successive operations. Time and money are lost. If such a procedure is necessary in certain cases we must practically always try to do primary suture.

#### ADVANTAGES

The advantages of primary suture are unquestionable. The wounded men do not suffer so long they completely escape the grave danger of secondary infection so frequent among open wounds. One can state a comparison in the hospitals of the interior 80 per cent of the wounded men showed streptococcus in their wounds while among the recent

ly wounded they were found in only 10 to 15 per cent. Among cerebrocranial wounds within the first months after suture the mortality descended from 14 to 10 per cent since we have systematically performed primary suture. Functional restoration is likewise obtained more completely and quickly. It is obvious that a flexible non adherent scar would not be likely to produce anoplasm and this has been rather frequently seen in cases with old adherent scars. Besides these first advantages from the economical standpoint there are several factors of first importance. Fewer attendants are necessary there is less shock as most of the wounded men become cured with only one dressing as in civil practice nowadays due to the great necessity of recovering cotton it is easier to recover unsoiled cotton and the outlay of cotton is less there is considerable economy of hospital days and annuities as the wounded men are cured more quickly and the end results are better. Finally from the military point of view this method is of capital importance. All the cases with large wounds of the soft parts are entirely cured about the twentieth day and are able to resume work. Those with fractures leave the ambulance with closed fractures often already united. One of my evacuations contained 59 primary reunions among 61 wounded. The requisites for obtaining constant results are as follows.

Place by the side of a competent surgeon (having correct technique) a competent bacteriologist. Let them keep their wounded men a sufficient length of time to follow them until they are completely healed—about fifteen days. In proving that all war wounds containing no streptococcus can be sutured and thus cured Tissier has permitted us to realize the greatest progress obtained in war surgery since the beginning of hostilities. Until then primary suture was an uncommon procedure. Thanks to these works it is now a regular routine. In the future I am certain it will be the rule.

# DEPARTMENT OF TECHNIQUE

## A METHOD OF EXPOSING THE MUSCULOSPIRAL AND THE POSTERIOR INTEROSSEOUS NERVES

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STACY CHILD, F.D.

A. P. f. f. A. m. y. L. y. f. M. h.

IN the repair of certain injuries of the musculospiral nerve it is frequently necessary to expose the nerve in the greater part of its course. Many times both above and below the injury the nerve must be identified and followed in order to find the course. The more usual method is the spiral incision beginning below and following the line of the nerve. There are certain disadvantages to this incision. Unless it is made properly, however, the nerve is considerably lifted and may be met in locating it and further dissection of the tissue becomes necessary. It is sometimes extremely difficult thus to find the nerve when the incision approximates fully the elevation points. Such is the disadvantage of any incision which runs parallel to a nerve particularly if it follows a winding course. Furthermore, the spiral incision at the triceps tendon is. If it is literally the nerve is placed as it does not the nerve throughout the greater part of its course. When nerve graft or tubulization is to be done the danger of infection and further cicatrization is thus increased. For the above reasons the spiral incision is usually replaced by an alternative.

The authors present this method of incision for the exposure of the musculospiral nerve in the following order of the three major muscles, namely, the triceps, the deltoid and the biceps.

The first incision is in a line from the tip of the olecranon to the posterior angle of the acromion. The incision is made in three finger breadths below the acromion and continues laterally down and along the arm to 5 centimeters below the level of the insertion of the deltoid. The incision is carried directly through the deep fascia. At the upper angle of the wound the posterior border of the deltoid and the long and outer head of the triceps can be identified. The head

of the triceps are separated in their fascial plane by blunt dissection. The deltoid is retracted. If necessary a small part of the latter muscle may be cut. The epaulation of the two heads of the triceps is carried down to the lower angle of the axillary fold, a possible line of junction. After separating the muscle fibers a glissading of the nerve presents this incision and the nerve exposed. The lower border of the tendon of the triceps major muscle. The exposure thus gained is excellent and little damage is done.

The second incision runs parallel to the first except in the lower part where it is slightly curved toward the anterior. The incision should be made about 2 centimeters above the antecubital fossa external to the brachial anticus and between it and the ulno humeral longitudinal fiber of the supinator longus (the usual incision is generally not sufficiently perpendicular and is too far anterior—near the belly of the biceps). If the second incision is correctly placed it will fall over the triceps between the brachial anticus and the supinator longus in which the lower third of the musculospiral nerve is to be found. By careful dissection the nerve can be traced into the antecubital fossa at the point at which it divides into the radial and the posterior interosseous.

The nerve in its upper and lower third is thus exposed. By carefully following the course of the nerve in the fascial plane beneath the triceps and through the intermuscular septum by means of a blunt dissection a groove may be opened. By utilizing the canal thus opened, even if one of the musculospiral nerve might be united by means of nerve graft or other procedure without further dissection. However should a more complete exposure be required a third incision may be made midway between the other two and a par-

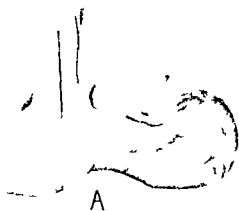
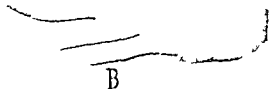


Fig. 1. Lines of incision for exposure of the musculospiral nerve.

The position of the skin incision for exposure of the upper third of the musculospiral nerve is as follows. It is placed on a line from the lateral epicondyle of the humerus to the tip of the acromion and extends from three fingers breadth below the acromion distally downward in the long axis of the arm for about 12 centimeters. The incision for exposure of the middle third of the nerve may also be taken. (The apparent curvature of this line is due to perspective—it is actually a straight line parallel to the first.)

allel to the first. It should extend from 3 centimeters above the level of the insertion of the deltoid directly downward for about 12 centimeters. The incision is carried through the triceps separating the fibers longitudinally until the aponeurosis on its deep surface is seen. This is carefully incised and the nerve exposed directly beneath. A complete new skin incision need not be performed. Either of the above incisions may be prolonged in an oblique or curved manner and the skin edges undermined. The additional exposure is then obtained by carrying the incision as above described longitudinally through the deep structures. This incision is close to that given by Schwartz and Kuess. Both of them alone give free exposure of the musculospiral nerve only in its middle third.

These three parallel longitudinal incisions expose the musculospiral nerve from the lower border of the teres major muscle to the antecubital fossa with the least possible damage to the overlying tissues. The muscle fibers when cut longitudinally are damaged but little and the sensory skin supply frequently completely destroyed by a spiral incision is in a great measure retained. Thus the main objections to a spiral incision are avoided and a free and easy exposure obtained.



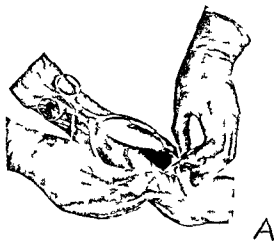
The lines of incision for exposure of the lower and middle third of the musculospiral nerve are here shown. The latter is made nearly perpendicular except in its lower third where it turns slightly anteriorly. It should extend to the brachial anticus and be given at a depth perpendicular to the axis of the ulnar nerve. Generally the incision is placed so far anteriorly and is curved more than the curve. The incision for the middle third of the nerve is made as between these made for the upper and lower third and parallel to the former. It is placed just outside the head of the ulna and extends from a point 3 centimeters above the level of insertion of the ulnar nerve distally downward for about 12 centimeters.

The rather perpendicular course of the musculospiral nerve is not anticipated from the usual anatomical descriptions. The nerve is essentially perpendicular in its upper and lower third, being spiral only in a small portion of its middle third. Perhaps this is the reason why a spiral incision frequently does not lie over the course of the nerve the precise position of which it is difficult to estimate. In such cases considerable dissection in further efforts to find the nerve must be undertaken.

*Posterior interosseous nerve.* This nerve is not infrequently severed or involved in callus following injuries of the radius, particularly in explosive wounds of the elbow joint in which the radius may be shattered. When injured it causes considerable disability due to paralysis of the extensors of the thumb and fingers. The extensors of the wrist receive their nerve supply by branches above this level. The technique of suturing the posterior interosseous is rendered difficult both by its relatively small size and by its inaccessibility.

For this exposure the arm is slightly flexed across the lower abdomen with the hand semi-pronated. The prominence of the external condyle and the radial border of the extensor communis digitorum are identified. By rapidly mov-





A



B



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 Th l l E d d f p h p h p

ing the various fingers without extension of the wrist the common extensor may be recognized. External to it lie the extensores carpi radialis. An incision 12 centimeters long is carried from the external condyle directly downward along the line between the extensor communis digitorum and the extensores carpi radialis through the deep fascia. Beginning at the lower angle of the wound the interspace between the muscles is identified and they are separated by blunt dissection until as their common origin. Here the muscle fibers are cut longitudinally up to the external condyle. This last step is essential in order to obtain adequate exposure. The muscles are then widely retracted and the common extensor aponeurosis on the deep surface of the muscle mass exposed. Its free medial border can be readily found, freed by blunt dissection and retracted with the extensores carpi radialis thus exposing the obliquely running fibers of the supinator brevis. The fibers run anteriorly and downward toward the flexor surface of the forearm. The posterior interosseous nerve is within or beneath this muscle. It runs at almost right angles to the muscle fibers diagonally across the radius toward the extensor surface. At a point two fingers breadth below the condyle the fibers of the supinator brevis are separated in the direction of their course by blunt dis-

section with two tissue forceps. In the opening thus made the flat posterior interosseous nerve will be seen (see Fig. 3-1). Having thus found the exact position of the nerve the supinator brevis is cut both above and below thus exposing it freely without danger of injury. The posterior interosseous nerve is thus laid bare in the main portion of its course. Without the step involving the separation of the muscle fibers by blunt dissection at right angles to the nerve difficulty may be encountered in finding it. It should be a principle of nerve surgery never to attempt an incision parallel to a nerve having a spiral course. The slightest error in placing the incision necessitates further difficult dissection and needless destruction of tissue. Should it become necessary to expose the posterior interosseous nerve higher than this incision affords the lower incision described above for the musculospiral nerve should also be made.

The author believes that this technique for exposure of the musculospiral and posterior interosseous nerve from the mere major muscle to the termination of the main stem of the latter has distinct advantages over the usual spiral incision. By longitudinal incisions running across the course of the nerve it is immediately found without additional search.

## NECESSITY FOR SPECIAL POSITIONS IN THE ROENTGENOGRAPHIC STUDY OF SHOULDER CASES

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IN the roentgenographic study of the shoulder joint the usual routine anteroposterior plates are not sufficient and a negative diagnosis based upon such plates is open to severe criticism.

George<sup>1</sup> has recently emphasized the necessity of multiple plates and especially plates in abduction and external rotation for the recognition of shadows occurring in so-called subdeltoid bursitis. The position he found most valuable was as follows: With the patient in the recumbent posture the affected shoulder flush on the plate the upper arm abducted to a right angle rotated outward the forearm flexed at the elbow to about 45 degrees and the opposite shoulder slightly elevated by a sandbag.

For the past five years we have been using as a routine in the examination of shoulder cases a somewhat similar position differing only in the degree of abduction. With the patient supine the forearm has been flexed at the elbow and the upper arm fully rotated externally. By this procedure there is some abduction of the humerus but not to the degree recommended by George. This would seem to be an advantage as the degree of pain produced is apt to be proportional to the degree of abduction.

The especial value of this position of extreme external rotation is that the greater tuberosity of the humerus and the tissues attached thereto are brought into profile whereas in the ordinary position the greater tuberosity lies on the anterior



Figure 3. Anteroposterior view of the shoulder joint showing a fracture of the greater tuberosity. The fracture is clearly visible as a dark line across the greater tuberosity.

Figure 4. Lateral view of the shoulder joint showing a fracture of the greater tuberosity. The fracture is clearly visible as a dark line across the greater tuberosity.

surface of the head of the humerus. This is well illustrated by Figure 1 and 2.

We thoroughly agree with Georger regarding the value of such a position for discovering abnormal shadows beneath the acromion process. This is well illustrated by Figure 3 and 4.

We do wish to emphasize the absolute necessity

of such position for the recognition of fracture of the greater tuberosity. During the past few years we have seen several cases in which the routine anteroposterior plate appeared perfectly normal but in which the plate of the externally rotated arm disclosed a fracture of the greater tuberosity (Figure 5 and 6).

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Volume XVIII  
January-June, 1919

PRINTED BY  
THE SURGICAL PUBLISHING COMPANY OF CHICAGO  
3 NORTH MICHIGAN AVENUE, CHICAGO